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A NOTED INNOVATION IN LIGHTING.

The paper presented by Mr. Bassett Jones, Jr., before the Illuminating Engineering Society on the lighting of the Allegheny County Soldiers' Memorial, an abstract of which appears elsewhere in this issue, marks what must in a measure be considered a new epoch in architectural lighting. For it is the first example, so far as we are aware, in which the full resources of the illuminating engineer in the matter of colored lights have been marshaled to aid the architect in carrying out his designs. Moreover, so far as we are aware, this is the first important building in which the architect and the illuminating engineer have gone hand in hand and the design of the illumination has been a part of the fundamental plan of architecture and decoration. From the architectural standpoint the building will doubtless provoke discussion, since modern architects have been uniformly somewhat fearful of utilizing color effects at their full value. Most of the attempts at such work have been half-hearted and some of them characterized by bad taste; but there can be no reasonable doubt that color is as legitimate a part of architectural effects as is form, and, as Mr. Jones points out in this very interesting paper, the free use of color is only a reversion to the classic period, in which color was lavishly used, not only upon interior decorations, but even upon the statues of the best periods of Greek and Roman art. More than this, color was very freely employed by Saracen and Moor and in the days of the Italian Renaissance. It is only in comparatively recent times that the architects became timid, perhaps from painful consciousness of their own limitations, and public taste was so changed as to repress the use of striking color schemes in architecture. Yet the canons of taste vary from generation to generation by some mysterious sort of periodic law that in turn lauds as harmonious and damns as garish the same structures and effects.

Perhaps we may be coming now to a period in which another Alhambra will be possible and are forgetting the monochromatic severity of the decadent Middle Ages. At all events the structure here under discussion is notable not only from the free use of color in decoration, but even more for the ingenious and harmonious way in which Mr. Jones has made the illumination a fundamental part of the decorative scheme. To do this he has resorted very freely to indirect lighting and has employed not only colored screens, but colored illuminants. It is in this latter feature that his work presents the most striking innovation upon ordinary practice. It is a simple enough conception to realize that when one wants yellow light it can be obtained readily from the flaming arc, just as one can obtain other tones from ordinary incandescents, from the mercury arc, and from the vacuum tube, but it took no small amount of daring to strike boldly out and utilize the full resources of modern illumination in giving color where color was needed. To apply colored lights harmoniously required the solution of some very tough problems in diffusion. The experiments carried out to obtain suitable uniformity, color and brilliancy in illumination

hidden behind translucent elements in the ceiling were very thorough and ingenious and are fully described in the paper. Eventually specially shaped reflectors coated with zinc oxide paint met the difficult requirements and were variously adapted to the purposes they were to serve. For a mellow golden tone a combination of tungsten lamps and amber glass was found the steadiest and most efficient source of illumination. Elsewhere yellow flame arcs were employed for their decorative effect in combination with nitrogen tubes, shedding a pale pinkish glow, and with mercury arcs toned to a soft sky-blue by colored glass. These latter illuminants were used solely for effect, since the particular results sought could not be obtained for certainty and brilliancy in any other way. The sum total, however, is by no means an inefficient illumination, particularly from the standpoint of first cost, since in the main auditorium, where this combination was used, the expense of suitable fixtures would have been exceedingly high had a more conventional method been selected. The total flux efficiency reached of about 25 per cent is far from bad, particularly when one considers the necessarily elaborate reflecting system and relatively high efficiency of the sources which could be employed.

One of the extremely interesting problems which were met in the course of the work was the adjustment of the illumination to secure the proper degree of relief in the decorative elements of the interior. It was found, for instance, that when the lighting in some respects was at its very best the architectural results were far from satisfactory and it became necessary to work the problem over and over until the lighting was finally made to reinforce the decoration and bring out the full value of the architectural features, and so the work went on until the illumination and decoration became a unified whole in final result as in original conception. It is essentially a new type of illumination, not merely a convenience or adjunct, but an integral part of the decorative whole. There may be and probably will be difference of opinion among architects as to the value of the precedent thus established; but given the fundamental idea of full use of color effects in a great interior its logical outcome is necessarily unity as between the illumination and the architecture, and this Mr. Jones seems to have secured in a highly ingenious and very remarkable manner.

REGENERATIVE CONTROL ON DIRECT-CURRENT RAILWAYS

An inviting problem for the electric railway engineer is that relating to the return of energy to the line when descending grades or coming to rest under normal conditions. Many solutions have been offered to the problem, and not a few have reached the experimental stage, yet the fact remains that the accepted railway equipment is one in which no attempt is made to restore energy to the system. The polyphase induction motor, being inherently a constant-speed machine, has proved well suited for regenerating control while descending grades, but its use for energy restoration during retardation involves such complications that the extra equipment for this purpose is usually omitted. The direct-current equivalent of the polyphase induction motor—that is, the shunt-wound motor—has been used to a limited extent for traction but the results have not been highly encouraging. A much more promising machine for regenerative-control purposes is the adjustable-speed motor. As noted in the Digest in this issue, the so-called B. V. D. adjustable-speed motor has been developed especially for traction purposes. The motor is provided with certain series coils occupying a portion of the main field core so as to overcome the distortion of the main field by the armature m.m.f. It is not apparent in what respect the motor would operate more satisfactorily than the commutating pole motors provided with armature-compensating field coils, such as have been in use for many years for driving machine tools.

VOLTAGES AND CURRENTS IN THREE-PHASE CIRCUITS.

The interlinked three-phase, three-wire system, as used so widely in industrial practice, would be a relatively simple system to analyze, both graphically and arithmetically, if the generator or generators supplying the system were star-wound and if the load on the system were also connected in star. But it usually happens that the connections are made in delta with the system, at either the receiving or the generating point, or at both. This introduces some complication into the distribution of currents, voltages and powers, but even then the complication would not be serious if the system remained balanced both as to voltages and currents. When, however, such a mixed star-delta system is unbalanced, the complication introduced by having the supply and load in delta, with the currents along the mains in star, becomes considerable. The problem has certainly presented itself in a large number of cases and engineers have found various methods of solving it at different times. We print this week two articles bearing on this subject. One, by Mr. B. F. Jacobsen, on "Currents in Delta-Connected Circuits," discusses the currents in the sides of a delta-wound generator supplying certain observed line-currents to the system. The other, by Mr. Chesley H. Johnson, on "The Solution of Problems in Star-Connected Unbalanced Three-Phase Circuits," treats of the vector diagrams of unbalanced star loads of known impedance connected to a given delta-triangle of three-phase line voltages. These two articles are in some respects mutually supplementary.

In dealing with the three observed line currents Mr. Jacobsen constructs from them a current-triangle. Within this triangle, assuming that the three delta supply currents differ 120 deg. in phase, he finds, by the superposition of a three-pointed star on tracing paper, a particular point such that the three distances thence to the vertices measure the three required delta currents. If the phase displacement of the three unknown delta currents is not uniform, then, as the article points out, the method fails, except that, as an upper limit, no delta current can exceed the greatest observed line current. What is needed for solving the problem with unbalanced delta phases is a pair of wattmeter readings and a pair of voltmeter readings. The tracing-paper method for assigning the branch point within the triangle is similar to one published in our columns a few years ago. In order to solve the vector diagram of an unbalanced star load, Mr. Johnson first lays off three delta line voltages and arbitrarily assumes one of the three required star-branch voltages. With this assumed branch voltage as a starting point he determines the other two in order that the combination of the three shall equilibrate the given line delta-voltage system. He then plots the vector currents in the star branches from the known admittances of the loads in the same and finds a certain result, which, in order to be self-consistent, requires the first assumption of star voltages to be correspondingly modified. The modified system is then the required system. In

other words, the method starts off with an arbitrary hypothesis, of which the error is unknown, but which when followed up logically leads to a certain result inconsistent with the facts. The assumption is then modified so as to make the inconsistency disappear, whereon the required solution is attained. The method is interesting not only because of its arriving at the goal by a flank attack, but also because it separates the currents into two groups, the active and the reactive respectively, branch by branch. A method of frontal attack on the problem was devised by Dr. A. E. Kennelly and published in our columns in 1899. The delta triangle of voltages having been drawn, the three star-branch admittances are attached to the proper respective corners of this triangle as "masses" of the complex or vector type. The center of gravity of the triangle thus loaded is then found by the methods of statics interpreted vectorially, assuming the triangle itself to be without mass. The center of gravity point is then connected with the vertices by three straight lines, which are the three vector drops in the respective branch loads whence the three star currents follow by Ohm's law.

DISCUSSION ON VECTOR-POWER IN ALTERNATING-CURRENT CIRCUITS.

We have received from Dr. C. P. Steinmetz a reprint copy of his interesting discussion on the paper on "Vector-Power in Alternating-Current Circuits" read before the American Institute of Electrical Engineers at the Jefferson convention last June. As was pointed out in that paper, two methods of presenting alternating-current vector diagrams are in vogue, side by side, in the technical literature of this country and of Europe. Some writers draw a lagging-current vector as a straight line making a negative angle with the vector of driving e.m.f., while others use a positive angle with a graphical construction otherwise the same. Dr. Steinmetz is a stanch advocate of the latter method. The dissension is not of recent development. It has existed since 1889 at least. Dr. Fleming used the negative angle for a lagging current as early as 1887, and Mr. Blakesley followed suit in 1889, if not earlier. Dr. Kapp took the positive angle for a lagging current in 1889, and Dr. Steinmetz followed Dr. Kapp, although for somewhat different reasons. Similar divergences occurred among European writers. The result has been that the whole world of alternating-current technologists is to-day split up into two schools of opposing graphical delineation and mode of thought, as unrelenting in their attitudes as were the Big-endians and Little-endians in Dean Swift's story of the nation that resorted to civil war over the question whether eggs at the breakfast table should be broken open at the big end or at the little end. About two-thirds of the textbooks follow the Fleming-Blakesley school and about one-third the Kapp-Steinmetz school, althoubh these numbers are not of prime importance in the discussion. There is a like confusion in the technical literature of Germany, France, Austria, Italy, Sweden, Denmark, Norway, Switzerland and probably of other countries also.

Unfortunately, it is not a matter of indifference which method of vector representation is adopted. Some men in writing the date on a letter put the day number before the month number and others the month number before the day number. Whichever way we personally adopt we rarely feel inflamed with righteous indignation at the Philistines who use the degraded opposite practice, because the inversion is so easy in the process of apprehension, and the worst that can happen is an occasional misunderstanding. But vector diagrams are stepping stones for the mind to travel over in order to avoid deep-water mathematics, and we unconsciously base our reasoning upon the particular graphical constructions that we visualize when thinking of an alternating-current phenomenon; and few men are so ambidextrous in their mental operations that they can visualize readily in either direction of vector rotation. Doubtless some men refuse to read papers employing vector diagrams of the unholy type opposite to that they are familiar with, thus creating an artificial ignorance of the whole subject. Moreover, the algebra of the subject is involved in the confusion, because one school uses the complex term $(r+jx)$ to represent the impedance of a choking coil and the other school necessarily uses the same term to represent the impedance of a condenser in series with a resistance. This divergence runs through the whole complex alternating-current algebra, so that sometimes it is hard to tell, when taking up a paper or book, which method the writer uses, and there is no way of settling the algebra confusion until the geometry confusion is settled.

In view of the above regrettable state of affairs the American Institute of Electrical Engineers voted at the above-mentioned Jefferson convention to appeal to the International Electrotechnical Commission to consider the question of standardizing the direction of the alternating-current vector rotation and to pronounce a decision upon the matter. It was felt that such a decision, emanating from an international body of such high standing, would surely lead to subsequent international unification. The American delegates presented this vote to the Brussels conference of the commission last August, and the conference voted in favor of taking up the question with a view to reaching a decision at the meeting in 1911, if possible. Meanwhile, briefs on this question are to be sought for and interchanged. We should be glad to open the matter to discussion in our correspondence columns. We think that the more the question is studied the more it will appear to be essentially one of pure convention, as distinguished from scientific necessity or axiom. Each school claims to be based upon a fundamental mathematical basis. Thus the crank-diagram school points out that it uses a trigonometrical basis, while the polar-diagram school points out that it uses the well-known polar-co-ordinate method of plane geometry. It is certain, on the one hand, that as long as we employ rectangular-co-ordinate diagrams to represent wave-forms we shall connect them with their rotating and projecting crank-vectors. On the other hand, it is certain that some engineers will always continue to make polar diagrams of alternating-current vector properties. It will, therefore, be necessary to select one and only one international standard direction of vector rotation and to bring both the crank diagram and the polar diagram into conformity with the same. This can be done without difficulty either way. The important and sole desideratum is, therefore, an international agreement one way or the other. It is much more important for all to agree on one method, even if the choice is not the best, than to continue in the present incongruous confusion. The difference between the two is relatively small, and either plan can be taken as correct. Certain advantages pertain to the method of each school and it is a mere question of a balance of advantages.

The Inventors' Guild.

In the early part of 1910 several men who had done work along the line of invention and who, in developing and patenting their inventions, had come to realize the difficulties and disadvantages under which the inventor labors instituted a movement for the formation of a society looking toward the betterment of these conditions. The result of this movement was the formation and incorporation in New York City of the Inventors' Guild, the object of which is briefly outlined in the following quotation from the constitution of the society:

"The object of the guild is to advance the application of the useful arts and sciences, to further the interests and secure full acknowledgment and protection for the rights of inventors, to foster social relations among those who have made notable advances in the application of the useful arts and sciences."

Some of the handicaps to which the inventor is subject, other than the proverbial one of never having any money, are the delays in the Patent Office and the ineffectiveness of its work, due to overcrowding and lack of proper facilities in that office; the expense and tardiness of litigation, and the possibility that a rich and powerful corporation, by delaying and prolonging a suit, may increase the expenses to a point which makes such suits prohibitive for a poor inventor; the disadvantage to which the American inventor is subject in foreign patent offices, as compared with the liberality of the American Patent Office toward the foreign inventor, and many other conditions militating against the American inventor which should be remedied.

The membership of the Inventors' Guild is limited to fifty. The reason given for limiting the membership is that with a small society of this sort it is easier to accomplish real results than with a larger organization, hampered as it must be by unwieldiness and red tape. Further, with a small organization each man will feel that he is a working unit and that he will be depended upon to do real work, whereas in a large organization the general feeling is that there will be planty of other men to do the work and that lack of assistance from any particular member will make little if any difference. The result is that in the large organization the work, if any, is usually done by even a smaller number of members than that provided for in the Inventors' Guild.

It is proposed to select the membership of the Guild carefully and to this end a member must be formally proposed by a member of the Guild, must be personally known to five members of the Guild, must pass the membership committee and board of governors, and finally must be voted upon by the whole membership, 4 per cent of the votes cast being sufficient to reject a candidate. The object of such discrimination is to include among the members of the Guild men who not only have made inventions, but who have achieved some measure of success in connection therewith and who will therefore be capable of exerting some influence, and also that no one shall be admitted who will not be congenial to practically the entire membership. The annual meeting of the Guild is fixed for the third Wednesday in March, the place of meeting being New York City.

The officers of the Inventors' Guild are as follows: Mr. Ralph D. Mershon, president; Mr. Chas. W. Hunt, first vice-president; Mr. Chas. S. Bradley, second vice-president; Mr. Thomas Robins, secretary, and Mr. Henry L. Doherty, treasurer. The board of governors are: Messrs. Ralph D. Mershon, Leo H. Baekeland, Chas. W. Hunt, Chas. S. Bradley, Michael I. Pupin and Peter Cooper Hewitt.

The professional committee are: Messrs. F. L. O. Wadsworth, chairman; Thomas A. Edison, Chas. S. Bradley, Peter Cooper Hewitt, Michael I. Pupin and Bion J. Arnold.

At the present time the Guild has twenty-nine members, as follows: Messrs. Bion J. Arnold, Dr. L. H Baekeland, W. H. Blauvelt, Chas. S. Bradley, Alex. E. Brown, Henry L. Doherty, Thomas A. Edison, Carleton Ellis, Stephen D. Field, James Gayley, Edward R. Hewitt, Peter Cooper Hewitt, Chas. W. Hunt, Dr. John F. Kelly, T. S. C. Lowe, Ralph D. Mershon, Ambrose Monell, Prof. Edwin F. Northrup, Prof. G. W. Pierce, Chas. E. Pope, Prof. Michael I. Pupin, Thomas Robins, Dr. F. Schniewind, C. H. Smoot, Prof. Carl Thomas, F. L. O. Wadsworth, Arthur West, Dr. W. E. Winship and B. F. Wood.

Underwriters' National Electrical Association Loses Its Identity.

The National Board of Fire Underwriters has transferred to the National Fire Protection Association the work of the Underwriters' National Electrical Association and the committee of consulting engineers of the national board, the former body being now known as the electrical committee of the National Fire Protection Association. The national board considers that the National Fire Protection Association is the logical organization for the assumption of all important codification work, its work in recent years in fire prevention, as well as protection, having entitled it to a high place among the engineering bodies of the country. Moreover, it is a public body with its membership open to any individual, firm or corporation upon payment of $5 per year. All interests affected may, through membership, have a voice in the compilation of underwriters' codes, all of which will hereafter be issued under the authority of the larger body. The membership of the newly formed electrical committee of the association is as follows: Messrs. F. E. Cabot, Ralph Sweetland, J. E. Cole, C. M. Goddard and H. O. Lacount, of Boston; George E. Bruen, J. C. Forsyth and Charles Lum, of New York; William S. Boyd, Dana Pierce and B. H. Tousley, of Chicago; Washington Devereaux and C. H. Hill, of Philadelphia; A. M. Paddon, of Syracuse; A. M. Schoen, of Atlanta, and R. P. Strong, of New Orleans. The committee will also include a representative of the American Institute of Electrical Engineers, the American Street & Interurban Railway Association, the National Electrical Contractors' Association and the National Electric Light Association. All electrical men will regret the disappearance of the Underwriters' Electrical Association and the subordination of its work in the larger and electrically unrelated body. The Electrical Association, which held honorable rank with the national electrical organizations, had a record of accomplishment that invited a better fate.

Brooklyn Edison Employes' Profit-Sharing Plan.

On Monday, Dec. 12, the directors of the Edison Electric Illuminating Company of Brooklyn announced a profit-sharing and pension plan which will go into effect at once and apply to the year 1910. While the plan is adopted for the current year only, it will be continued from year to year if the board of directors approves. The distribution of profits and pensions will be in charge of a committee to be known as the provident committee, consisting of two directors, the general manager, general superintendent and treasurer. Any matters upon which this committee is not unanimous will be determined by the executive committee of the company. Following are the details of the profit-sharing and pension allowances:

All credits will be paid in cash to the trustees of the Brooklyn Edison Investment Fund. Employees of two years' service will receive annually a percentage of their salary or wages equivalent to one-quarter of the rate of dividend paid on the capital stock during the year. This is increased to one-half of the dividend rate for three years' service, to three-quarters of the dividend rate for four years' service and to the full dividend rate for five years' service or more. Money credited in any year's account cannot be withdrawn within three years, except with the consent of the provident committee or to make payment upon the purchase of a home, or because of the death of the employee or of necessity in the opinion of the committee. All moneys or credits accruing will revert to the company or to the

investment fund in the event of an employee being discharged for misconduct, or who leaves the company without giving one month's notice in writing, unless the necessity of this notice is waived, or if an employee without the consent of the committee assigns to anyone any interest he may have in the money, or if an employee becomes insolvent or bankrupt. The committee may also withhold a part or all of the share of profits to which an employee might otherwise be entitled if it wishes. In case of the forfeiture of an employee's profits the committee may give the money to his family. After three successive annual sums have been credited to any employee the committee on request will deliver a stock certificate at a price equal to the average cost price of the stock held by the Brooklyn Edison Investment Fund. Upon the death of any employee his profits may be immediately withdrawn by his family, next of kin or legal representative. No restrictions are placed upon the withdrawal of dividends declared by the investment fund upon the profit-sharing investment of employees.

According to the pension regulations any employee who has attained the age of sixty-five years and been at least ten years continuously in the service of the company may be pensioned either at his option or that of the company; or an employee who has been at least ten years continuously in the service of the company and has become unfitted for full duty may be retired and pensioned. The pension allowance is for each year of continuous service not less than 1 per cent nor more than 2 per cent of the average pay received for the five years next preceding retirement, provided that no pension shall exceed 50 per cent of the wages paid at the time of retirement, exception being made in the case of employees whose annual salaries exceed $2,500, whose pensions shall be fixed by the executive committee of the company. The directors reserve the right to establish a new and lower basis of pension allowances if at any time it shall be found that the basis adopted will create demands in excess of $25,000 a year. The pension allowances are to be paid monthly in the life of the beneficiary, but in case of misconduct the allowance may be withheld or discontinued. No assignment of pensions will be binding.

Street-Lighting Tables.

With the present issue there is given, in the form of a supplement, our annual street-lighting schedules prepared in conformity with a plan followed continuously since June 28, 1890, when the schedule devised by Mr. W. H. Frund was first published. Our issue for May 31, 1890, contained the announcement of the Frund schedule, which is an ingenious compromise between the so-called Philadelphia or moonlight system and the "all-night and every-night" lighting schedule. The tables as prepared by Mr. Frund were published monthly until March, 1895, when a complete table was prepared for the remainder of that year. Since 1895 the tables have appeared annually as a supplement to an issue in December. A copy will, as usual, be forwarded gratis to any central station upon application.

According to the table designated as No. 1 the lamps are lighted one-half hour after sunset and are extinguished one hour before sunrise. By such a plan the lamps are in service for about 3830 hours per year. An "all-night" lighting schedule giving a total of about 4000 hours could be obtained by lighting fifteen minutes earlier and extinguishing fifteen minutes later than shown.

Table No. 2 is the "Philadelphia Moonlight Schedule" referred to above. This schedule differs from that of Table 1 in that advantage is taken of moonlight, beginning with the fourth night after new moon—that is, after the moon has reached its first quarter. On moonlight nights the lamps are extinguished one hour after moonrise and lighted one hour before moonset, with the exception of the night before, the night of, and the night after full moon, when the lamps are not lighted. This schedule involves the use of the lamps for about 2000 hours per year.

Table No. 3 is calculated according to the well-known system of Mr. Frund, and ignores the moon until midnight throughout the year. After midnight the lighting hours are the same as in Table No. 1 except that the lamps are not used on the three nights before full moon. According to this schedule the lamps are used for about 3000 hours per year.

All of the tables are based on mean local time and are calculated for latitude 40 deg. north. They may be considered correct within ten minutes for any place in New York, Connecticut, Pennsylvania, Rhode Island, New Jersey, Ohio, Indiana, Illinois, Iowa, Delaware, Maryland, Virginia, West Virginia, Kentucky, Missouri, Kansas, Nebraska, Utah, Colorado, Nevada and northern California. They are also correct within ten minutes for all places within the United States proper during the months of March, April, September and October. The maximum disagreements are reached in June, when the nights are shorter in the Northern than in the Southern States, and in December, when the reverse is the case. During these months the disagreement along the northern border of the United States and as far south as Charleston, Birmingham and Los Angeles will not exceed twenty minutes. A maximum disagreement of one-half hour may be assumed for Jacksonville, Fla., and Houston, Tex.

Chicago Sanitary District Plans and Report of Operation.

At its meeting of Nov. 23 the Board of Trustees of the Sanitary District of Chicago, on the recommendation of President McCormick, authorized the president to appoint a commission to investigate and report to the board a comprehensive plan of developing the increased water-power which will be created by the widening of the Chicago River and by the construction of adjuncts and additions to the main drainage channel. Further, the commission is to report on methods of disposing of the electrical energy of the Sanitary District to all municipal bodies within its boundaries, and to investigate and report upon the proper methods of keeping the water supply of Chicago pure by the treatment of sewage by methods other than by the system of dilution now in use.

The commission, as appointed later by Mr. McCormick, consists of Mr. G. M. Wisner, chairman; Dr. W. A. Evans, Mr. E. B. Ellicott, Mr. C. D. Hill and Mr. Martin C. Schwab. Mr. Wisner is the chief engineer of the Sanitary District; Dr. Evans is the health officer of Chicago; Mr. Ellicott is the electrical engineer of the District, and Messrs. Schwab and Hill are independent engineers. The sum of $12,000 has been appropriated for the purpose of making this investigation, and it is provided that the two independent engineers shall receive not to exceed $1,000 each for their services. The commission is empowered to purchase materials and supplies and to employ such assistance as may be needed in the pursuance of its investigations.

With the North Shore channel of the drainage canal completed, and with the permit of the Calument-Sag channel obtained, it is believed that the greatest problem before the District is the most effective use of the water-power now created and to be created, and also a comprehensive study of the sewage-disposal problems of Chicago and the smaller municipalities embraced within the Sanitary District.

The present generating equipment at the drainage-canal power house at Lockport, Ill., consists of six 4000-kw units. Work is soon to be started on the foundations and draft tubes for the seventh unit. As this work will involve the construction of a cofferdam on the downstream side of the power house and the pumping of the water out of the space underneath the proposed unit, it can be done only at such times and under such conditions as the operating of the generating plant will permit. It is not considered practicable to endeavor to do this work by contract, and on the recommendation of the electrical engineer of the District the District will do the work itself. An appropriation of $5,690 has been made for this purpose and the work will be carried on under the supervision of Electrical Engineer Ellicott.

Mr. D. M. Deininger, comptroller of the Sanitary District, has submitted a report to the Board of Trustees of the financial operation of the electrical department during the nine months ended Sept. 30, 1910. The total cost of the plant and equipment of the hydroelectric department of the Chicago Drainage Canal is shown to be $4,375,720. The largest item entering into this investment cost is $1,881,408 for dams, canals and bridges. The next largest is $439,413 for power-plant building, while $420,191 has been expended for "miscellaneous transmission lines," $370,819 for electrical generator equipment, $222,245 for distribution system, $203,466 for terminal-station equipment, $140,828 for other substations and equipment, and $146,989 for turbines and water-wheels.

The income of the electrical department for the nine months was $409,960, showing an increase of $132,211 over the corresponding period for the preceding year, or 47.6 per cent. The operating expenses, including the amount set aside for depreciation for the nine months, were $171,068 and the net earnings $238,892, an increase of 83 per cent compared with the preceding year. From the net earnings $126,049 is deducted for interest on cost of plant, taxes and rentals, leaving $112,843 carried on profit and loss account.

Mr. Deininger says that with only a few exceptions all expired contracts with consumers have been renewed, while the others are being held in abeyance temporarily pending adjustment of contingencies. Only occasional minor complaints have been received, and these have been confined wholly to the lighting service. During the nine-month period sixty-five lighting and three motor-service consumers discontinued the use of the service and 130 new lighting consumers and fifty-seven motor consumers were connected. The sixty-eight consumers shown as having discontinued the service were lost, Mr. Deininger says, for various reasons, such as moving of plant, going out of business or inability to pay bills. The comptroller says that, with allowance made for depreciation, the net earnings from operation for the nine months ended Sept. 30, 1910, were at the rate of 6.153 per cent per annum. The rate of depreciation given is 1.681 per cent per annum.

Wisconsin Telephone Taxation.

The taxation of telephone companies on the ad valorem basis, instead of on their gross earnings, as is now the system in Wisconsin, is recommended by State Treasurer A. H. Dahl in his annual report. Mr. Dahl shows that fifty-eight telephone companies escaped taxation completely during the past year, while their property amounted to $70,000, which would furnish about $8,000 of taxes under the ad valorem system. A total of $19.26 is paid by forty-five other companies, whose property valuation is $85,000, in amounts varying from 1 cent to 9 cents. These companies would furnish $9,000 of taxes on the ad valorem basis. Mr. Dahl adds: "The American Telephone & Telegraph Company has benefited by this extremely unfair method of taxation by approximately $70,000 in the last eleven years." Mr. Dahl says in the report: "It would seem that this example and the results obtained in increased revenue through the ad valorem system from railroads, street railway and telegraph companies are sufficient proof of the advisability and fairness of extending this system to all companies in the State."

Commercial Motor Vehicle Association Formed in Boston.

Twenty-five dealers in commercial vehicles held a meeting at the Hotel Lenox, Boston, on Dec. 6 and organized the Commercial Motor Vehicles Association of Boston. Mr. L. B. Butler was elected president, and the electric vehicle interests are represented by Mr. Day Baker, of the General Vehicle Company, secretary. The principal topic of discussion was the question of holding a motor-truck show in Boston during the late winter, and a committee was appointed to confer with Mr. Chester I. Campbell, manager of the Boston Automobile Show, in regard to the expediency of carrying out such a plan. It is expected that in the near future all the motor-truck associations in New England will be co-ordinated into a single organization.

President Taft on Federal Water-Powers.

In his message to Congress President Taft recommends that federal water-power sites be directly leased by the federal government, after advertisement and bidding, for not exceeding fifty years upon a proper rental and with a condition fixing rates charged to the public for units of electric energy, both rental and rates to be readjusted equitably every ten years by arbitration or otherwise, with suitable provisions against assignment to prevent monopolistic combinations; or that the law shall provide that upon application made by the authorities of the State where the water-power site is situated it may be patented to the State on condition that the State shall dispose of it under terms like those just described, and shall enforce those terms, or upon failure to comply with the condition the water-power site and all the plant and improvement on the site shall be forfeited and revert to the United States, to the President being given the power to declare the forfeiture and to direct legal proceedings for its enforcement. Either of these methods would, the President states, accomplish the proper public purpose in respect to water-power sites, but one or the other should be promptly adopted. He said that the question of conservation is not a partisan one, and expressed the hope that even in the short time of the present session consideration may be given to those questions which have now been much discussed, and that action may be taken upon them.

Ohio Telephone Situation.

The annual meetings of the Cuyahoga Telephone Company and the United States Telephone Company, both of Cleveland, Ohio, have been delayed by the fact that the litigation preventing the transfer of the securities to J. P. Morgan & Company has not been entirely cleared away. When this is done and the voting trusts have been reorganized the meetings can be properly held. It is said that the Cuyahoga Telephone Company will be reorganized and the official headquarters of the United States Telephone Company will be moved to Columbus, where the operating department is now located. These conditions are standing in the way of all plans that may have been made for the Independent companies of Ohio for the future.

Councils of many Ohio cities and towns have responded to the request of the Cleveland City Council with a promise to exert all the influence possible for the enactment of a law that will give cities the right to supervise and regulate the telephone service within their limits. The Cleveland Council is now investigating the service furnished by the two companies for a second time, and will furnish data for the use of the members of the Legislature. In all probability a hard fight will be made for a law of the nature mentioned.

A new automatic system has been installed by the Independent company at Bucyrus and a contract has been made under which all the subscribers of the Central Union will eventually be turned over to it. The lines of the American Telephone & Telegraph Company have been connected with the new exchange and will receive its portion of the business. The local rates have been advanced about 50 per cent.

The City Council of Toledo, Ohio, at its last meeting passed an ordinance declaring forfeited the franchise granted the Harrison Telephone Company in May, 1894, to build and maintain conduits in a number of the principal streets in the business section of the city. The Mayor is directed to notify the company of this action and five days are then given to remedy

the alleged breach of conditions of the ordinance. The city authorities claim, however, that nothing can be done to remedy the matter. The ordinance contained a condition that the Harrison Telephone Company, if it sold out to a competing company, would forfeit its franchise for the conduits. The company finally did sell and transfer its business to the Central Union Telephone Company. The Postal Telegraph Company is now paying the Central Union a rental of $5,000 a year for the privilege of occupying a portion of the space with its lines. The city took action in order to secure proper rentals from property which it considers has reverted to it. If the Mayor signs the ordinance the city may bring mandatory injunction proceedings to compel the company to remove its wires or, on the other hand, it may begin to tear out the wires and compel the company to seek an injunction to test the question of ownership.

Ballinger on Federal Water-Powers.

In his annual report Secretary of the Interior Ballinger recommends the passage of legislation which will retain the fee title of water-power sites in the people, invest the power of regulation and control in the State or in the federal government and not result in limiting prompt and economical development or permit monopolization or extortion. There is now withdrawn from disposition, pending legislation concerning water-power sites, approximately 1,450,000 acres of the public domain. In the various public-land States and Territories containing water-power resources, in so far as there is present market for these powers, the title to areas greater in extent than those remaining to the government has long since passed to private ownership. Secretary Ballinger says it must be realized that any radical or burdensome restriction imposed by the federal government upon water-powers will operate as a restriction upon the public lands and discourage their development and use. Since the States own the waters in the streams and have public power to supervise and control public utilities, he believes that a direct and effective method of control would be to trustee the power sites to the States in some such manner as proposed by a bill now pending in Congress.

Municipal Ownership Defeated at Haverhill, Mass.

By a vote of 4780 to 1420 the citizens of Haverhill, Mass., at the regular city election on Dec. 6 killed the project of municipal ownership of the plant of the Haverhill Electric Company, which has been the center of popular interest for some months. The Haverhill company is one of the public utilities managed by the Tenney interests, of Boston, a well-known syndicate of progressive central station and gas administrators. Under the Massachusetts laws a city cannot acquire a plant until it has been so authorized by a two-thirds vote of each branch of the City Council passed in two consecutive years and thereafter ratified by the voters at an annual or special city election. The present referendum sustains the Massachusetts precedent of refusing to authorize a municipal plant in any community where the service is of high quality, the rates are reasonable and the operating company is on a sound business basis.

The agitation in favor of a municipal plant at Haverhill appears to have grown out of a desire in certain quarters to make political capital by attacking the existing company. A feature of the campaign, which has been won by the company entirely upon its record for square dealing with its customers, was an investigation by the Haverhill Board of Trade of the desirability of municipal ownership, which resulted in an emphatic veto of the project. The committee of this organization quoted the report of the National Civic Federation, which concluded that the municipal ownership of public utilities should not be extended to revenue-producing industries which do not involve the public health, public safety, public transportation or the permanent occupation of the public streets or grounds. It emphasized the necessity of investigating each case upon its own merits and pointed out that the real point at issue in Haverhill was whether the users of electricity or the taxpayers would be benefited by the city's purchasing the electric plant. The cost of acquiring the plant as a going concern was estimated at $1,000,000. The gross assets of the company on June 30 last were $968,000, and under the existing laws the company is entitled to recover from the city more than the cost of the plant's reproduction, namely, the value of the plant as a going concern. The committee pointed out that under Massachusetts laws the electric department of a municipality is obliged to pay the interest on its bonds, a sinking fund and 3 per cent depreciation on all its physical property, exclusive of land, out of its earnings. In case the earnings are insufficient to meet these expenses, then the difference must be made up from the tax levy. With an interest charge of 4 per cent on $1,000,000 and a depreciation charge of 3 per cent on $700,000, there would have been an additional sum of over $60,000, which the city must get either from the consumers of electricity or from non-users through taxation. The company's gross income for the year ended June 30 last at the rates then in force (a reduction has since been made to 12 cents per kw-hour) was $172,436. Its operating expenses, exclusive of depreciation, were $113,361, leaving a net return of $59,075. The balance sheet of June 30 showed the cost of the property, exclusive of land, to have been $725,879, upon which the city would have to charge off 3 per cent for depreciation, or $21,776. To this would have to be added $40,000 (interest at 4 per cent on assumed cost of plant to the city), leaving a deficit of $2,700 upon the city's hands at the old rate. At the present 12-cent rate the company's net operating revenue would be still further reduced by about $15,000, so that the city would have to make up a deficit of $17,701 per year.

The committee pointed out the futility of making a comparison between Haverhill and the Holyoke municipal plant, or between that of any other city and Haverhill. Among its power customers Holyoke has two which pay $56,000 per year for power, whereas only two customers of the Haverhill company take more than 100 hp, one taking 113 and the other 184 hp. An application of the Holyoke rates to the Haverhill business would have reduced the income of the company by $55,839, leaving a net deficit of about $58,000 per year. The committee pointed out that the rates charged by the Holyoke company for lighting, power and street illumination compare favorably with the varied rates charged by all private as well as municipal plants in Massachusetts. The company has offered to reduce the street-lighting rates from $100 to $86.40 per year at the expiration of its contract and plans progressive reductions in the maximum net price of electricity to a 10-cent rate when the business reaches a volume of $250,000 per year. Like all other Massachusetts companies, the Haverhill organization is subject to the jurisdiction of the Massachusetts Gas & Electric Light Commission in matters of rates, service and capital issues. The committee concluded that increased taxes might result from the purchase of the plant.

At the meeting of the Board of Trade on Nov. 30 the report of the committee was accepted by the organization and a number of additional points against municipal ownership were brought out. Mr. F. G. Gordon, Lewiston, Maine, pointed out that the city has in reality lost by municipal ownership in Cumberland, Ohio; Taunton and Holyoke, Mass. Advocates of municipal ownership cited the city plant at Jacksonville, Fla., as a shining example of its benefits, when a telegram was received from William Bostwick, Jr., chairman of the bond trustees in Jacksonville, which stated that under the conditions named at Haverhill municipal ownership was unwarranted by the expenditure necessary to attain it, with the further statement that Jacksonville has only $171,000 in bonds, pays no taxes or bond interest, and depreciation is carried as a book entry only. Mr. Gordon showed that the wages paid at Jacksonville are 30 per cent to 40 per cent less than at Haverhill and soft coal is cheaper. A certain merchant purchasing prac-

tically the same amount of electricity from the private plant at Springfield, Mass., and from the Holyoke municipal plant pays less in Springfield. Judge Ryan, of Haverhill, recalled the erroneous impressions of the cost of arc lighting in Chicago several years ago, it being found later that the actual cost was $100 per lamp-year instead of $60. A. Shirley Ladd also spoke of the absence of storage facilities for electricity and the need of reserve investment.

The Haverhill Electric Company was greatly hampered in the presentation of its case to the public at large by Chapter 581 of the Acts of 1907, which prohibits the expenditure of money by electric light and other companies for the purpose of influencing public sentiment on any question submitted to the voters. The company desired to place before the public in the advertising columns of the daily press a complete record of its work in Haverhill, including a résumé of the investments in late years in plant and underground equipment, adoption of more efficient street lighting and reductions in rates. After a well-rounded campaign of this kind had been planned it was found that it could not be carried out and the company was obliged to depend almost entirely upon its history in the community in securing the decision of the voters. The resulting defeat of municipal ownership in a distinctly socialistic city by a vote of nearly three and one-half to one is therefore a most gratifying indication of the company's standing in the community.

Electrical Credit Association of Chicago.

With a number of visitors from Western and Southern cities the fifteenth annual business meeting of the Electrical Credit Association of Chicago was held on the afternoon of Dec. 7. President Frank M. Pierce, of the Manhattan Electrical Supply Company, in his annual report reviewed the history of the last fifteen years, showing that the association has grown from eighteen members to the present number of 210. The report of Mr. Frederic P. Vose showed the total number of claims handled since the organization to be 27,931, aggregating $2,129,-459.81, and that of this number 17,153 had been settled, aggregating $1,408,749.84. The average amount collected during the year per each member was $1,075.82. The finances were shown by the auditing committee to be in a healthy condition.

Officers for the ensuing year were elected as follows: President, Frank M. Pierce (re-elected); vice-president, A. O. Kuehnsted, the Gregory Electric Company; members of the executive committee, E. R. Gilmore, Western Electric Company, and Ivar Hennings, Westinghouse Electric & Manufacturing Company. Amendments to by-laws were made in accordance with notices previously sent. These amendments, however, do not materially change the workings of the association as long in vogue. Papers were read by Mr. Thomas I. Stacey, Electric Appliance Company, on "The Executive Committee"; Mr. W. S. Thomas, Wagner Electric Manufacturing Company, on "What Does the Association Mean to Me?" Mr. C. F. Koepge, the Tungstolier Company, on "The Inside Workings of Our Association"; Mr. Fred B. Uhrig, Kansas City, on "Credits and Collections" (read by Mr. Gilmore); Mr. Hennings, Westinghouse Electric & Manufacturing Company, on "The Moral Risk Club of Chicago"; Mr. Clyde C. Miner, Robbins & Myers Company, on "The Way It Strikes Me." An open parliament of free discussion on nearly every subject relating to the association service and to credit and business conditions followed. The business meeting adjourned at 6:15 p. m.

In the evening the annual dinner of the association was held in College Hall at the University Club. Mr. Frank M. Pierce, the president, presided, and after proposing a toast to the absent turned the management of affairs over to Mr. John F. Gilchrist, Commonwealth Edison Company, who performed the duties of toastmaster most acceptably. The first toast was responded to by Mr. Merritt Starr, whose subject was "The Field of the Voluntary Association." He remarked that the two principles characteristic of a voluntary association of any sort were mutual need and free choice. An association such as that which he was addressing is established for the mutual benefit of its members and their customers. If the purposes of the association are legal, if its means are lawful and are also reasonably adapted to the objects of the association, the will of the majority of the members governs all the members of the association. If they wish, the members of such an association may boycott delinquent debtors, but they must not induce other bodies who have no direct interest in these debtors to take like action. That would be coercion, or the secondary boycott, which is unlawful. In an eloquent peroration Mr. Starr, who is a leading member of the Chicago bar, pictured the beneficent effect of trade and commerce on the progress of the world.

Rev. Dr. E. A. Paddock, president of the Idaho Industrial Institute, had for a subject "Humbugs I Have Met." He made a good speech to the effect that while Idaho has many advantages his hearers must be on their guard against wild-cat mining schemes and fraudulent land projects.

Judge Marcus Kavanagh had for a subject "Reminiscences of the Bench," and in the course of a speech which was listened to with deep attention he advocated certain reforms to remedy the law's delay—a subject in which the speaker, in common with other occupants of the bench of Cook County, is greatly interested.

Mr. W. G. McKitterick, of the National Electric Lamp Association of Cleveland, spoke on the "Relation of the Sales and Credit Departments." He gave a sensible business talk and commented on the aggressiveness, co-operation and good-fellowship manifested by the association. He favored a liberal credit policy in the case of first orders and closed, following a suggestion of Mr. Gilchrist, with a description of the beautiful island in Lake Ontario, near Henderson Harbor, which is the summer headquarters of the lamp association.

Mr. H. A. Antram gave some recitations and earlier in the evening there was lusty singing of popular songs, led by Warren Ripple. An excellent dinner, fine orchestral music and the setting of one of the stately halls of the University Club all contributed to make the fifteenth annual dinner a success. The menu and list of toasts contained many clever scraps of poetry and mottoes that were apropos, and no doubt this was largely the work of Secretary Vose, who was conspicuous in the arrangements both for the annual business meeting and the dinner in the evening. The attendance at the dinner was over 100.

Electrical Men at National Commercial Gas Association Convention.

The sixth annual convention of the National Commercial Gas Association was held at Boston from Dec. 6 to 9, inclusive, President E. N. Wrightington being in the chair. Representatives of public-utility organizations from many parts of the country attended and the presidency for 1911 was given to Mr. C. N. Stannard, of the Denver Gas & Electric Company. Among the papers by representatives of combined gas and electric companies were the following: "Compensation of Representatives," by Mr. J. D. Shattuck, general manager, Philadelphia Suburban Gas & Electric Company; "Service," by Mr. C. W. Hare, new-business manager, United Gas Improvement Company, Philadelphia; "Rates," by Mr. Henry L. Doherty, New York; "Relation with Customers," by Mr. V. A. Henderson, Merchants' Power Company, Memphis, Tenn.; "Office and Accounting Methods," by Mr. Harry Hughes, Denver Gas & Electric Company, Denver, Col.

MR. H. L. DOHERTY ON RATES.

Mr. Doherty suggested the desirability of reform in the methods of charging for gas. He stated that perhaps no other one factor has contributed so much to the success of the electrical business as the study of the rate problem. Even the electrical business has only reached the point of what might be termed acute interest. Discussion of the rate problem has generally resolved itself into one of scientific cost analysis and has

given the electrical men a much keener knowledge of their costs and a much better idea of what constitutes profitable and unprofitable business, and has worked a radical change for the better in their commercial methods. Taking up telephonic analogies as useful in studying rate problems, Mr. Doherty showed how inequitable charges will curtail the volume of business done and cause the community to pay more for service as a whole than would be the case if a rational system of charging was used. He further showed that a system of charging which permits any business to be carried on at less than the cost to the company and prevents the acquisition of business which might be had on a profitable basis means that the community pays more for service than would be required under a rational system of charging. Inequity of charging tends to discourage development of business or to curtail it, whereas equitable rates tend to give the community the maximum service for the least cost. Scientific charging methods are applicable to almost every business, and it is a common error to justify inequities in one business by pointing out similar errors in other lines. Mr. Doherty said that he believed that the development of the science of charging and its universal application would do more to reduce the cost of service to the public than if it were possible for them to confiscate half the profits from all of the business enterprises. The public frequently looks for reduction in the cost of service from the wrong standpoint.

Aggressive commercial methods will doubtless do more for the development of sales than a reduction in price. The cost of service can be reduced to the consumer more by highly efficient appliances and good service than would result from cutting the price, hence the rate charged by the company is not identical with the cost to the consumer. Mr. Doherty reviewed the importance of a high load factor in gas work no less than in electrical service, and stated that the load factor, or ratio of average to maximum, in the gas meter is about 3 per cent; that of a gas service is about 1 per cent; that of distributing mains is about 10 per cent; that of feeder mains is about 15 per cent, of transmission mains 20 per cent, and of the gas works about 60 per cent.

Mr. Doherty explained the fundamental elements of cost in the supply of electric service, classifying them under consumer expense, demand expense and energy expense, and showing that this is the final basis upon which the reasonableness of rates is properly determined. The importance of making a reasonable profit from the business of each customer was reviewed and the point made that if a company is not compelled to do business at a loss with any customer, it tends to make it possible to supply the profitable customers at a lower rate. This will probably be the rate method toward which the industry will eventually work. In conclusion the author touched upon the history of electrical rate-making, pointing out the results of the work of Hopkinson, the Wright demand system and the Doherty "readiness-to-serve" methods of charging. Mr. Doherty stated that Dr. Hopkinson was the pioneer of the science of rate-making and that if he had dealt with present conditions he would have included the consumer charge. This is a negligible factor when electricity or gas is being supplied in large quantities, but under modern conditions it has become a factor of more importance than the demand charge. As the electrical business has developed the simultaneous maximum demand per consumer has greatly diminished. The well-developed central stations of to-day seldom have a simultaneous maximum demand of more than 0.4 kw per consumer, and in some cases it is below 0.3 kw. We can approximate the fixed charge of a central station at about $60 per kilowatt, if all fixed charges are apportioned on a kilowatt demand basis. Where the consumer charge is used it has become necessary to fix this charge at about $12. Hence if the maximum demand is 0.4 kw per consumer it amounts to $30 on a demand basis. In other words, $12 per consumer plus $30 per kilowatt of maximum demand would yield the same revenue as if no consumer charge was made as against a $60 charge per kilowatt of maximum demand; and in the case of 0.3 kw per simultaneous maximum demand the consumer charge at $12 would enable service to be sold at $12 per consumer plus $24 per kilowatt of maximum demand. The author concluded with an exhaustive bibliography of recent articles and books on the rate problem.

One feature of the convention was an address by President James L. Richard, of the Boston Consolidated Gas Company, upon the benefits of co-operation with the public, good service and publicity.

The Testing of Steam Turbo-Generator Sets.

In a paper by Messrs. E. D. Dickinson and L. T. Robinson presented before the American Institute of Electrical Engineers in New York on Dec. 9 an outline was given of the precautions that should be observed in testing steam turbo-generator sets.

The authors stated that the one positive method of testing a turbo-generator is to measure the steam that goes in through the throttle valve and the electric energy delivered at the terminals of the generator. The surest method of determining how much steam enters the turbine is to collect and weigh all the steam after it has been condensed. This necessitates the use of a condenser of the surface type. In making such a test it is essential that all the steam used on the turbine be condensed and measured and that no steam or water not used in the turbine be allowed to enter the condenser. The most accurate method of ascertaining the amount of steam condensed is by the use of tanks so arranged that all the water can be weighed at equal time intervals during the test.

When the turbine operates non-condensing or the condenser is of the jet type it is usual to weigh the water fed to the boiler. The liability to error is very great, and every precaution must be taken in order that the results may be considered reliable within any degree of accuracy. The leakage may amount to as much as 12 per cent and has been known to reach 20 per cent.

The method of test by heat balance, based on measuring the amount of heat transferred to the cooling water from the condensed steam, is extremely inaccurate and unreliable because of the difficulty of measuring the quantity of cooling water and its true average temperature change.

The only "efficiency" of any particular commercial value is the net over-all value as indicated by the ratio between the kw-hour output and the available energy in the steam. To determine the available energy in 1 lb. of steam it is necessary to know the pressure in pounds per square inch, the quality and the temperature of the entering steam; also the pressure at the turbine exhaust. To measure the exhaust pressure or vacuum a gage should not be relied on. The most accurate means is to use a full-length mercury gage and subtract the readings given by this from the atmospheric pressure at the time the test is made. If the steam be superheated, since there is some difference of opinion concerning the specific heat of superheated steam, the figure assumed must be specified. In testing turbines consisting of several stages, the pressures in the different stages should be measured. This affords a check and should show any abnormal conditions existing in the interior which might not otherwise be observed. The output should be net; that is, the kilowatts for excitation sould be subtracted from the generator output.

Whenever possible turbines should be tested under the conditions for which they were built to operate. Correcting for different conditions is always liable to throw some doubt upon the accuracy of the test. Different machines will have different correction factors for varying conditions, and for this reason it is impossible to fix arbitrarily the allowances that should be made. In general, the corrections for steam pressure, moisture or superheat are less liable to be misleading than that for varying vacuum, for the reason that comparatively large changes in any one of the first three will but slightly affect the conditions in the machine, whereas a slight change in the vacuum

makes an enormous change in the available energy and volume of the steam in the low-pressure end of the turbine.

Under suitable circumstances thoroughly accurate tests may be made by measuring the steam flow with a meter. Such tests will be more convenient than those made by any other method. Certain precautions are necessary, but there should be small expense in providing conditions that will insure reliable results with the best meters. Even where other methods of measurement are used the steam-flow meter will always be a valuable adjunct, since its readings are accurately proportionate to flow and show the conditions instantaneously.

For measuring the electrical output use should be made of indicating instruments rather than watt-hour meters. Single-phase indicating instruments for polyphase service are to be preferred for precision work to polyphase instruments, for the obvious reason that indications of a polyphase instrument are made up by the two elements in such a way that it is not possible to apply corrections to either element to get the true total result unless the division of load is known by single-phase instruments; if the single-phase instruments are required for this purpose they may as well be of the precision class and used for the actual determinations and the polyphase instruments omitted.

Discussion.

Mr. Gano Dunn remarked that the paper dealt principally with over-all efficiency determinations largely for the purpose of acceptance tests. Of equally great importance from an engineering point of view, and of even greater importance scientifically, are the detail tests of the separate machines making up the turbo-generator unit. It is important to know the proportion of losses chargeable to each machine. This is especially true when the turbine is made by one company and the generator by another.

Mr. W. L. R. Emmet stated that the losses in the generator portion of the unit can be determined by the retardation test in which observations are made of the rate at which the stored rotative energy is dissipated during retardation. He said that the losses in high-speed generators are much greater in many cases than generally supposed, by reason of the windage, leakage fluxes and eddy currents. The existence of the numerous losses that are difficult to calculate or measure separately makes it desirable to test the turbo-generator unit as a whole. In such tests a steam-flow meter is a valuable device; results obtained with it should be accurate within 2 per cent and can be made within one-half of 1 per cent.

Mr. Francis Hodkinson claimed that when the test of a turbine is based on the weight of steam condensed one hour is sufficient time for making the test run. A hydraulic brake provides a convenient means for observing the output.

Prof. W. L. Robb stated that not only should the steam conditions be the same under test as during normal operation, but the electrical load should be at the same power-factor. Neither a steam-flow meter nor a wattr-hour meter should be used as a basis for the final calculations, but both instruments should be in service at the time of the test for detecting irregularities in the operating conditions. Although a run of one hour after the conditions have become constant will give sufficient data for calculation of the efficiency, provided a surface condenser is used, a much longer test would be required if the steam consumption were ascertained from a measurement of the feed water.

Mr. E. D. Dreyfus presented data to show that consistent results can easily be obtained in testing steam turbines.

Mr. W. C. L. Eglin expressed the opinion that an acceptance test to be of any value should be made in the manufacturer's plant, where the conditions are under proper control and enough trained observers are available.

Mr. C. O. Mailloux called attention to the fact that when the turbine of a set is made by one company and the generator by another each company blames the other for all troubles arising in the set.

Mr. A. H. Pikler remarked that since the test of a turbo-generator unit is a duration test the time-integral of the output should be measured and not the rate of output. Thus use should be made of energy as well as power meters; that is, watt-hour meters as well as wattmeters.

Dr. E. B. Rosa said that electrical testing instruments now on the market give highly accurate results when properly calibrated. In all cases they should be calibrated before the test to prevent the use of any instrument found unsuited for the purpose; a subsequent calibration is desirable, but not so necessary as the prior calibration.

Mr. Robinson explained that many of the precautions listed in the paper might seem only too obvious, but observation has shown that the suggestions are necessary. The usual test is run by either a steam engineer or an electrical engineer; the former makes an accurate test of the turbine, but ignores many important details of the generator set, while the latter tests the generator properly, but neglects important features of the turbine test.

Steam-Consumption Tests of Large Turbines.

At the annual meeting of the American Society of Mechanical Engineers, held in New York, Dec. 6-9, two papers relating to tests of large steam turbines were presented and discussed.

Mr. F. H. Varney described tests on a 9000-kw vertical Curtis turbo-generator installed by the City of Oakland, Cal., in 1908. This installation, consisting of turbo-generator, boilers, steam piping and auxiliaries, building, crane and everything necessary for a complete steam plant, excepting land, cost $51 per kilowatt. Only 171 days elapsed from the beginning of the plans and specifications to the successful operation of the station.

When operating at 175 lb. gage pressure, 125 deg. Fahr. supertemperature, 28-in. vacuum, the steam consumption in pounds per kw-hour was guaranteed not to exceed 16.75 at an output of 5000 kw, 16.40 at 7000 kw and 16.40 at 9000 kw. Under test at a load of 6922 kw the consumption was found to be 16.06 lb. per kw-hour, while at a load of 8775 kw it was 15.95 lb. With corrections based upon 1 per cent for each 10 per cent change in pressure, or for each 12.5 deg. supertemperature, and upon 1.08 lb. per kw-hour for each inch change in vacuum, the corrected consumption was 15.42 lb. per kw-hour at the load of 6922 kw.

Mr. Sam L. Naphtaly outlined the design and operation of a complete-expansion, double-flow horizontal Westinghouse turbine of 10,000 kw normal rating installed in 1909 in the main generating station of the City Electric Company, San Francisco, Cal. The guarantee stated that the consumption should not exceed 16.2 lb. per kw-hour at 5000 kw, 14.3 lb. at 10,000 kw and 15.3 lb. at 15,000 kw when operating at a steam pressure of 175 lb. gage, 100 deg. Fahr. supertemperature and 28-in. vacuum. The generator was a 60-cycle, three-phase, 11,600-volt machine having an electrical efficiency of 92.2 per cent at one-fourth load, 97.6 per cent at full load and 98.2 per cent at one and one-half load. The tests showed the following steam consumption at the loads indicated: 15.655 lb. per kw-hour at 5333 kw; 14.572 at 9173 kw. When corrected for changes in vacuum, supertemperature and pressure the values become 15.21 and 13.88 at the loads recorded. The corrections were based on 1 per cent change in steam consumption per 10 deg. in supertemperature, ½ per cent for 10-lb. change in pressure and 3 per cent at full load and 6 per cent at half load for each 1-in. change in vacuum.

Discussion.

Mr. I. E. Moultrop commented upon the speed of erection and low cost of the 9000-kw station. He said that although the performance was better than the guarantee it was not especially creditable to the Curtis turbine. The vacuum could well have been improved and the supertemperature increased, thereby lowering the steam consumption; the increased cost of the installation would probably be fully justified by reason of the saving in operating expense. In view of the low supertemperature and vacuum used with the 10,000-kw turbine its efficiency

can be considered quite high. Mr. Moultrop reported the results of tests on a 3500-kw horizontal Curtis turbine which showed a steam consumption of 13.62 lb. per kw-hour and on a 5000-kw five-stage Curtis turbine unit which showed a consumption of 12.71 lb. per kw-hour with highest supertemperature and test vacuum but 13.57 under normal conditions.

Mr. E. D. Dreyfus stated that the new addition provided for the installation of the 10,000-kw turbine cost the City Electric Company $33.94 per kilowatt, including everything from the real estate up to and including the switching gear. By employing a speed of 1800 r.p.m. instead of 900 r.p.m. the unit has been reduced in length by about 17 per cent, the area needed being only 0.18 sq. ft. per kilowatt of rating.

Mr. G. A. Orrok presented a table showing the actual steam consumption of various steam turbines ranging from 11.95 lb. to 15.95 lb. per kw-hour. The power was for a machine operating at 29.19 in. vacuum, 289.3 deg. supertemperature and 179 lb. steam pressure, as compared with 28.03 in. vacuum, 72.95 deg. superheat and 194 lb. steam pressure for the latter.

Dr. D. S. Jacobus remarked that the indicated consumption of 15,000 heat units per kw-hour would correspond to about 22,000 units in the fuel at a boiler efficiency of 70 per cent. He stated that the value seemed very low, since the lowest figure on record, which was made at Oakland with oil fuel, is 25,000 heat units per kw-hour.

Mr. Francis Hodgkinson stated that it is incorrect to assume that a turbine designed, for example, for a 25-in. vacuum would necessarily be higher in efficiency than one designed for a 26-in. vacuum. Conditions other than the vacuum must be considered.

Mr. R. J. F. Pigott outlined the economical features of high-pressure turbines compared with reciprocating engines used with exhaust-steam turbines and expressed the opinion that no one is likely to build a large station having reciprocating engines and turbines.

Mr. W. L. R. Emmet called attention to the mechanical details of the 10,000-kw machine, and claimed that it should be rated at about 7000 kw instead of 10,000 kw.

Mr. W. L. Naters claimed that the mechanical features of the 10,000-kw turbine unit had been carefully designed, and the machine, which is the first of its kind, has proved so successful that it will doubtless prove a forerunner of an able line of high-speed units.

Energy Consumption of Passenger Elevators.

In a paper presented by Mr. Reginald P. Bolton before the annual meeting of the American Society of Mechanical Engineers in New York on Dec. 8 much information was given concerning the service performed by passenger elevators in buildings used for various purposes. In all elevators, particularly those electrically operated, the energy consumed per car-mile increases in proportion to the number of starts and stops. This is a natural result of the use of the electric motor, in which the largest part of the energy is required for the process of first motion and acceleration, the next largest for electrical and mechanical retardation, and a less amount for the actual running speed, with a small proportion devoted to the continuous excitation of the field. It, therefore, follows that in this form of elevator, which is now so widely used, the main part of the consumption of energy is directly related to the number of stops and starts which accompany and result from the number of persons carried. The diversities in results which have been reported from time to time as to the consumption of energy by electrical elevators may be attributed to variations in traffic conditions.

The author reported the results of a series of tests of an electric traction elevator in the ten-story office building of the Edison Electric Illuminating Company of Boston. With a total travel up and down of 203 ft. the consumption varied from 2.18 kw-hours per car-mile with only the operator as load to 2.93 kw-hours per car-mile with a total load of 2660 lb. When a total of sixteen stops was made during a return trip the consumption varied from 7.95 kw-hours for the operator alone to 7.97 kw-hours with a total load of 2010 lb. The elevator is rated at 2500 lb. and is designed for a speed of 550 ft. per minute. It is driven by a 200-volt direct-current motor.

Wisconsin Commission News.

The Railroad Commission has authorized the Wisconsin River Power Company to issue stock and bonds as follows:

Three million dollars par value of bonds, dated May 1, 1911, and bearing interest at the rate of 5 per cent. The denominations are to be $500 and $1,000. These bonds are to be issued for money only, for not less than 75 per cent of the par value, and in accordance with the terms of a certain mortgage or trust deed issued to the Continental and Commercial Trust and Savings Bank and Frank H. Jones, trustee, both of Chicago, Ill.

Twenty thousand shares of common stock of the par value of $100 each, being an issue of $2,000,000. This stock is to be issued for money only and for not less than par value.

The funds to be derived from the sale of the stock and bonds are to be used to supply the company with funds for the construction of a dam and hydroelectric power plant at a point on the Wisconsin River, near the City of Prairie du Sac, Sauk County, Wis., and for the construction and equipment of the necessary hydraulic and electrical works and the transmission systems.

The commission has dismissed the petition in the case of Timothy L. Harrington and others vs. the Milwaukee Electric Railway & Lighting Company. The petitioners alleged that the respondent company had made unreasonable charges for the power used in charging automobile batteries and that a minimum bill of $5 per month was excessive. The petitioner further alleged that the capacity charge of $1 per horse-power per month was based upon the capacity of the mercury-arc rectifier; that the rectifier would have been unnecessary had the respondent extended its direct-current lines so as to cover consumer's premises.

The commission did not deem it necessary to investigate the merits of the contention, for the reason that since the presentation of the above complaint the respondent company has filed additional optional schedules of rates designed to give concessions to off-peak users. The schedules referred to are the so-called "off-peak" and the "ten to seven" schedules. In the former a demand charge of $21 per kilowatt per year is made, where the service is not utilized during peak hours, plus an energy charge of 4½ cents for the first 100 hours, 3½ cents for the next 900 hours, etc.; in the latter but one-half the demand charge is assessed where the consumer contracts to utilize the company's service only during the hours of from 10 p. m. to the following 7 a. m.

Under these optional schedules, which the petitioner is in a position to take advantage of, the cost of power is materially reduced. The commission found, moreover, upon an investigation of the cost of service, that unless the consumer uses his current for more than three hours daily the cost of serving him is greater than the revenues that would be derived from these services under the optional schedules given above and that consequently no reduction in rates could be considered.

The petition in the case of the Mt. Horab Electric Light Company for authority to increase its rates has been dismissed by the commission. The case arose out of an application to increase rates for municipal incandescent lighting service. As no attempt had been made to keep the company's books in compliance with the "Uniform Classification of Accounts," as prescribed by the commission, or in any complete manner whatsoever, it was impossible to make a complete financial analysis of the company's business. However, the facts, meager as they were, seemed to indicate that the municipality is contributing its just share to the earnings of the company; that a readjusment of commercial rates, apparently justifiable, may well be postponed until such time as the company's accounts and station

records are in shape to substantiate other conclusions. In the comparison made between the rate at Mt. Horab and other communities of similar size it was noted that the charge that the petitioners sought to have increased, namely, 0.658 cent per lamp per hour, was already somewhat above the average of 0.488 cent per lamp per hour.

The commission has approved the application of the Greenwood municipal light plant for authority to put into effect a minimum rate of 40 cents per month. The minimum charge should yield a return equal to the consumer cost and an additional amount to cover the value of the smallest amount of energy used by any class of consumer. Inasmuch as the petition called for a certain definite minimum charge the commission did not concern itself with the determination of a minimum charge based upon total costs as outlined above, but confined itself to the question as to whether a 40-cent minimum charge was excessive or not. That it was not was clearly shown by the following table made up of the items of depreciation and interest from average figures representing the usual value in the smaller plants and the items of maintenance, consumer's premises expense and collection expenses, which costs represent the average for all Class B electric utilities reporting these items.

Interest on meters and services @ 7% on $14.00	$0.98
Depreciation on meters and services @ 7% on $14.00	0.98
Maintenance of meters	0.50
Consumer's premises expenses	0.34
Collection expenses	0.73
	$3.53

The meter expense amounts to roughly 30 cents per month, and although this value may not represent the actual cost to the applicant it is fairly representative of costs per meter consumer for smaller electric utilities.

As the difference between 40 cents and 30 cents very obviously is less than the value of the smallest amount of energy used by any class of consumers, the 40 cents minimum charge could not be excessive.

New Jersey Commission News.

The Board of Public Utility Commissioners of New Jersey has decided that an electric light company has the right to exact a minimum charge. The opinion was rendered on the complaint of a consumer that the Dover (N. J.) Electric Light Company had submitted a contract by the terms of which a monthly minimum charge is exacted of $4.50, based upon a charge of 5 cents for each 16-cp lamp or equivalent. The board referred to a New York case, Gould vs. Edison Electric Illuminating Company, in which it was held by the court that a minimum monthly charge of $1.50 was not illegal, but compensatory for that part of the service which is at all times being rendered in the maintenance of the apparatus and connections through which electricity is made available to the consumer. Two points in the Dover case were held over for consideration, namely, to what extent, if any, the right of the company to make a minimum charge is affected by the terms of any contract between it and the municipality; and whether the charge of 5 cents per 16-cp lamp is reasonable.

The board recently received an inquiry from the City Clerk of Ventnor City asking whether, under the public utilities act, a telephone company seeking a franchise is restricted from furnishing free telephone service at public buildings, such as fire house, city hall, police department and public schools. The act recites that no public utility shall give, grant or bestow upon any local, municipal or county official any discrimination, gratuity or free service whatsoever. The board requested an opinion from the Attnorney-General as to whether furnishing free telephone service at public buildings would conflict with this provision of the law. The Attorney-General has advised the board that "the language of the statute quoted has regard merely to such discrimination, gratuity or free service as may be granted or bestowed upon the class of officials described by its terms. The discrimination and gratuity forbidden is purely personal in its scope. In my opinion this provision of the act would not prevent the granting of a franchise to a telephone company by a municipality when, by the terms of the franchise, free service was to be furnished the fire house, city hall and other public departments within the confines of the municipality. Such free service might well be one of the moving considerations in the granting of the franchise and does not, in my opinion, fall within the evil which the statute just quoted sought to eliminate."

New York Commission News.

The commission will hold a hearing during the present week on the application of the Hoosac River Electric Light & Power Company for permission to construct its lines in the Town of Pittstown, Rensselaer County, and to issue capital stock.

The Middleport Gas & Electric Light Company has been authorized to exercise franchises granted for the furnishing of electric lighting to the Town of Royalton, Niagara County, N. Y.

Maryland Commission News.

Formal protest was filed with the Maryland Public Service Commission last week by residents along the Emory Grove car line against the action of the United Railways & Electric Company in suspending at once all commutation fares on that and all other lines and especially in abolishing the 7½-cent rate to nearby suburban points. Demand is made that the commission shall compel the Railways Company to return to the tariff schedules filed with the commission Sept. 16 of this year. The petition charges that the company acted hastily in abolishing all commutation rates, following a protest from residents of Ellicott City, with regard to alleged discrimination in favor of residents along the Catonsville-Irvington line.

The hearing before the commission last week on the protest against the proposed new schedule of rates of the Chesapeake & Potomac Telephone Company was slimly attended. While there are more than 800 holders of limited service contracts in the city, all of which will be affected by the proposed change in rates, and thousands of persons more or less interested in the contemplated action of the telephone company, there were but very few subscribers present at any one time while the hearing was in progress and of these there were scarcely two who agreed fully as to what was required of the company. Some favored unlimited service, while others seemed positive that limited service was the only cure for the evils that the telephone user is said to endure. Early in the session it was evident that those in attendance came each to present individual complaints, not so much against the contemplated change in rate schedules as against the alleged delinquencies of the company in rendering service, and it was this note that was continually sounded throughout the whole hearing.

Mr. W. W. Varney, an attorney who appeared in his own behalf as a subscriber, questioned the right of the Public Utilities Commission to sit in the case in a judicial capacity and quoted legal references to show that the Public Utilities Commission lacked jurisdiction to fix tolls and rates, not having had that power conferred on it by legislative act, and that, in consequence, the commission was powerless to act as a judicial body in passing upon the proposed rates of the Chesapeake & Potomac Telephone Company. Chairman Ambler ruled that Mr. Varney's challenge of authority was not in order; that, as the commission believed that it was vested with authority to control public-service corporations and as the commission would continue to act in accordance with this belief, the contention of Mr. Varney was a matter for the courts to settle.

Preliminary plans providing for the construction of an elec-

tric railway from Salisbury to Nanticoke Point, a distance of thirty miles, were filed with the commission. The charter for the road was passed by the Legislature of 1908. The commission is asked to approve the plans, so that the work can be begun. The application was filed by former State Senator Marion V. Brewington, and while several Marylanders are interested in the project New York and Philadelphia capitalists are expected to furnish the bulk of the money to finance the enterprise. The line, which will haul both passengers and freight, will pass through Jesterville, Bivalve, Tyaskin, Quantico, Hebron and other towns.

The commission heard the protest made against the plan of the Frederick Street Railway Company to acquire the majority of the stock of the Frederick Gas & Electric Company. Some weeks ago the railway company filed with the commission an application for acquiring control of the lighting company. A number of the stockholders of the street-car company are opposed to the plan and they were represented at the hearing by Mr. Charles H. Freuauf, of New York. Mr. Robert P. Graham represented the street-car company. The commission has the protest under consideration.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has authorized the Plymouth Electric Light Company to issue new capital stock to the amount of $30,000 at par value, the price being $100 per share. The proceeds are to be applied toward paying the cost of power plant improvements made since a fire which destroyed the company's generating equipment in part about a year and a half ago.

The Railroad Commission has issued a finding sustaining the Old Colony Street Railway Company in the petition of the Selectmen of Abington relative to reduction in rates between Abington and Brockton. In its decision the board points out that it is practically impossible, in view of local conditions throughout the State, to determine the reasonableness of rates for street railway fares exclusively upon the proposition of mileage.

The Selectmen of Weston, Wayland and Sudbury have petitioned the Railroad Commission to fix the route of the Boston & Western Electric Railroad Company in these towns following the granting of a certificate of necessity to the company by the board. The Northampton Street Railway Company has petitioned the board for authority to issue $300,000 in additional capital stock for the purpose of paying indebtedness incurred in retiring bonds maturing in the past two years. The directors have fixed the price of the stock at $100 per share.

The various state commissions are making final arrangements to report to the incoming Legislature early in January, 1911, upon a large number of matters assigned by the General Court of 1910. Among the more important questions to be discussed are the electrification of railroads at Boston, the laws bearing upon electric power transmission, acquisition of stock, control of outside companies by the Boston Elevated Railway Company and various Boston subway extensions.

Canadian Hydroelectric Commission News.

In an address to the members of Middlesex County Council at London, Ont., on Dec. 8 Hon. Adam Beck, chairman of the Hydroelectric Commission, announced that the commission would supply "hydro power at cost" to every community that wants it. Mr. Beck stated that the commission would, in supplying the smaller communities, operate on the same principle as the municipal telephone system. Whenever twenty farmers went to a county council and requested the erection of a distribution line the commission would erect the low-tension lines tapping the main transmission high-voltage lines and construct the low-tension feeders to the residences of the farmers, who would pay off the cost of construction of the low-tension lines in the same manner as paying for a local improvement, retiring the indebtedness at the end of fifteen or twenty years.

The offer of the City Council of London, which has contracted for hydroelectric power, to purchase the stock of the London Electric Light Company for $100,000 and assume the bonded indebtedness (referred to in the issue of Dec. 8), was refused by the directors of the company at a meeting held in Toronto the following week. Subsequently the management of the company at London announced that there will now be severe competition between it and the city plant for the business of the consumers in London. The company has reduced the rate for lighting from 9¼ cents to 5 cents per kw-hour, with a discount of 10 per cent, making the rate 4½ cents net per kw-hour.

The Water and Light Commissioners of the city, on the other hand, say that the company cannot afford to do business at these rates very long, and they have decided not to lower their rates beyond the figures announced on the Saturday previous, when they published a reduction in the house-lighting rates for Niagara power from 4 cents to 2 cents for a fixed charge on the floor-space basis. The average consumer of electricity in London has 600 ft. of floor space, and at 2 cents per 100 ft. he would pay a fixed rate of 12 cents per month. It is also figured out that he would use 8 kw-hours of energy at 4 cents per kilowatt, making a total charge of 44 cents for the month, less 10 per cent discount, making the net rate 40 cents per month.

Commenting on the refusal of the directors of the London Electric Company to accept the city's offer of $100,000 for their company, the press states that as the control of the company is in the hands of the same interests that control the Toronto Electric Light Company, which is now in negotiation with the Toronto city corporation looking toward the purchase of that plant by the City of Toronto, the directors of the London company acted as they did having before them the fact that their action in the case of the London company would have an influence on their negotiation with the Toronto City Council in the sale of the larger Toronto Electric Light Company's plant and business.

As a result of a conference between General Manager H. H. Macrae, of the Toronto Electric Light Company, and Corporation Counsel H. L. Drayton, for the City of Toronto, an understanding has been reached whereby Engineer R. A. Ross, of the Hydroelectric Commission, and Engineer Expert Alex. Dow, of Detroit, for the city corporation, will be permitted to make an inspection of the physical assets of the Toronto Electric Light Company at an early date for the purpose of submitting a valuation to the City Council as a basis to enable the Council to formulate an offer for the purchase of the Toronto Electric Light Company.

AMERICAN ELECTRICAL ENGINEERS.—XXIII.

Valere A. Fynn

Valère Alfred Fynn, of County Galway, Ireland, was born at Krasno on April 11, 1870. He was sent to Switzerland at the age of ten, where he went to school first in Geneva, then in Lausanne and Grenchen and finally in Zürich. In 1887 he entered the mechanical engineering department of the Swiss Federal Polytechnic in Zürich, where he completed the regular three and one-half-year course of mechanical engineer, including practical shop work, and remained another year making a special study of electrotechnics under Professor H. F. Weber.

From 1892 to the end of 1895 Mr. Fynn was employed by Messrs. Brown, Boveri & Company, of Baden, Switzerland, doing testing, designing and erecting work. He was intrusted with some of the firm's most important work at the time, as, for instance, the erection of the three-phase plant at the Gerlafingen steel works, of the two-phase hydraulic central station in Aarau and the well-known single-phase steam power plant in Frankfort-on-Main. In 1895 he accepted the post of chief

electrical engineer to Messrs. Easton, Anderson & Goolden, Ltd., of Erith, Kent, England. While occupying this position he redesigned all of the company's line of direct-current machines, discarding the smooth-core armature, so very popular in England at the time, and introduced slotted armatures throughout and also developed a line of alternating-current machinery. While in Erith he patented a number of improvements in direct-current and alternating-current machinery which were widely used in England for a number of years by various firms.

In February, 1899, Mr. Fynn joined the firm of Rosling & Appleby, of Bradford (Yorkshire), as chief electrical engineer and shortly after became a partner. Rapid progress was made and it soon became necessary to build new works, which were erected by a newly formed company of which Mr. Fynn was a director. In 1898 he designed his unity power-factor, single-phase commutator motor, but the overhauling soon after of the

Valere A. Fynn.

designs of the above-mentioned firm delayed the immediate development of this invention. It was not until 1902 that he was able to build and test the machine, and thereafter most of his time was devoted to the study of the single-phase motor.

In 1903 Mr. Fynn abandoned manufacturing and began work on his own account as consulting engineer, making a specialty of supplying designs to various firms and advising them in special work. His single-phase motors were taken up by the Electricitäts Gesellschaft Alioth, which manufactures them in Switzerland and France, and also holds the patents for Germany, England, Italy and Spain. His machines are also built by the General Electric Company of London.

Since 1895 thirty British patents have been granted to Mr. Fynn, of which eight relate to single-phase commutator motors, five to commuted windings, three to the protection of electric circuits, two to methods for improving the power-factor of alternating-current motors, two to direct-current generators, and ten deal with dynamo-electric machines, electromagnetic couplings, variable-speed single-phase shunt motors, alternating-current generators, motors and converters, split-phase motors, and single-phase railway motors. Twenty-four United States patents granted to Mr. Fynn since 1897 may be divided into six groups. One group covers starting and phase-compensating arrangements for single-phase induction commutator motors having a "shunt" characteristic and includes what is said to be the first United States patent for phase compensation in such motors. The second group relates to the methods for adjusting the speed of single-phase induction commutator motors with "shunt" characteristics. The third group covers single-phase conduction commutator motors having a "shunt" characteristic and means for adjusting their speed, improving the power-factor and regulating the starting conditions. The fourth group discloses means for compensating polyphase commutator motors with "shunt" characteristics and adjusting their speed. The fifth group relates to means for improving the starting characteristics of single-phase squirrel-cage induction motors, and the sixth group deals with constructive details of alternating-current and direct-current motors and generators. Those of his United States patents which have been issued have been acquired by the Wagner Electric Manufacturing Company, of St. Louis, for which he has been acting as consulting engineer since 1908, spending some months each year in St. Louis.

Mr. Fynn has presented papers before the (British) Institution of Electrical Engineers entitled: "A New Single-Phase Commutator Motor" (1906), for which the institution premium was awarded, and "Torque Conditions in Alternate-Current Motors" (1907). Among articles contributed to the technical press are the following: "The Design of Direct-Current Machinery" (*Electrical Review*, London, 1903 and 1904); "A Contribution to the Theory of the Single-Phase Induction Motor" (*Electrical Review*, London, 1906); "The Classification of Alternate-Current Motors" (*Electrician*, London, 1907); "No-Load Conditions in Self-Excited Single-Phase Shunt-Induction Motors" (*Electrical World*, 1909); "Factors Affecting the Design of Self-Excited Single-Phase Shunt-Induction Motors" (*Electrical World*, 1909); "Characteristics of the Asynchronous Single-Phase Shunt-Induction Generator with Mixed Excitation" (*Electrical World*, 1910); "Characteristics of the Asynchronous Single-Phase Shunt-Induction Generator with Self-Excitation" (*Electrical World*, 1910).

Mr. Fynn is a member of the American Institute of Electrical Engineers and the (British) Institution of Electrical Engineers.

CURRENT NEWS AND NOTES.

Philadelphia Section Meeting, I. E. S.—The Philadelphia Section of the Illuminating Engineering Society will hold a meeting on Dec. 16, at which time a paper entitled *The Lighting of a Large Stable Building* will be presented by Mr. L. B. Eichengreen.

Turbo-Generators for Naval Use.—In the report of the Bureau of Equipment, the work of which is now merged in other bureaus of the Navy Department, it is stated that experience with turbo-generators for ship lighting plants has confirmed the intention not to purchase reciprocating engines for this purpose except in special cases.

New Mexico Hydroelectric Plant.—Steps are being taken by the Water Users' Association, composed of land owners in the Rio Grande Valley, New Mexico, to erect a hydroelectric plant in connection with the Elephant Butte dam and land reclamation project. Mr. W. E. Anderson, engineer of the association, has reported the cost of the hydroelectric plant and transmission lines as $325,000. The main object in view is to provide electric power for operating irrigation pumps.

Naval Electric Cooking.—The Bureau of the Navy Department which has had cognizance of cooking appliances states in its annual report that extensive tests with electric baking and cooking appliances have demonstrated the superiority in many respects of electric ranges and bake ovens over the ordinary type using coal and provisions have been made for installing them on battleships and submarines building. It has also been found advantageous in some cases to replace steam heaters by electrical heaters on board large vessels.

Automobile Feeder to Railway.—It is stated that the Boston & Maine Railroad Company will employ automobiles as feeders for its summer-resort business in the White Mountain region. The automobile service will cover about seventy miles.

Storage Battery Lecture.—Mr. Walter E. Holland, of the Edison Laboratory, will deliver a lecture on the subject of "The Edison Storage Battery" before the Electrical Engineering Society of Columbia University at 8:15 p. m., Friday, Dec. 16. The meeting will be held in the Engineering Building of the university.

Electric Club of Chicago.—Capt. William Brooke, U. S. A., addressed the Electric Club of Chicago on Dec. 7, on "The Needs of the Service," dwelling on the need of enlarging the regular army establishment of the United States. Messrs. F. B. Badt, O. D. Steele, H. W. Fowzer, F. J. Postel and others took part in the discussion of an interesting non-electrical meeting.

Fixation of Atmospheric Nitrogen.—A paper will be presented by Dr. E. F. Roeber on "Fixation of Atmospheric Nitrogen" at a meeting of the New York Section of the American Electrochemical Society to be held at the Chemists' Club on Dec. 16. The paper will treat of the general status of the development, the three principal commercial processes and the uses proposed for the products. Dr. Charles S. Bradley, one of the pioneers in the art, will participate in the discussion.

Gas Rates.—At the recent meeting of the Commercial Gas Association Mr. Henry L. Doherty presented a paper on "Rates" in which he advocated a differential system of charging for gas service, based on a charge uniform for all consumers, a demand charge of a uniform amount per unit of demand and a charge for gas of a uniform amount per unit of gas. The paper is accompanied by an extensive bibliography of papers and articles on the subject of rates for electrical and gas service.

Electrical Operation of Pumping Station, Chicago.—The Department of Public Works of the City of Chicago has asked the City Council for authority to install electric pumps at the West Side municipal water works pumping station on Ashland Avenue near Twenty-second Street. Energy for the operation of these pumps is to be obtained from a feeder line which the Sanitary District is about to install in Blue Island Avenue, and the operation of the installation, when completed, will call for about 2000 hp for twenty-four hours daily.

Electric Vehicles for Central-Station Service.—The wagons of the San Joaquin Light & Power Company will be replaced by automobile trucks, five of the new vehicles having been ordered by General Manager A. G. Wishon. Three of these will be used in Fresno and the other two will be used in Bakersfield. In addition to these auto trucks small runabouts have been ordered for use of the local solicitors of the company, looking to a general displacement of horses by electric vehicles.

Tungsten Lighting in Chicago Park.—The new eleven-acre park and playground being completed by the South Park Commissioners, at the corner of Princeton and Forty-fifth Streets, will be lighted entirely by tungsten lamps mounted on concrete pillars. This park will be one of the most completely equipped playgrounds in the city. More than 100 molded concrete posts carrying single lamps or tungsten clusters will be employed in the illumination scheme. The units will be installed at a height of 10 ft. above the ground to conform to the requirements of the dense foliage of the new park tract.

Colorado Electric Club.—At the Thursday lunch of the Colorado Electric Club on Dec. 8 Gen. Chase, of the National Guard, gave a talk on the national defense, the position of the National Guard and our abnormally small fighting force. The absolute necessity for training a large body of men before we get the trouncing which will otherwise come to us sooner or later was his main theme. He was followed by General McAllister, who supplemented certain points and spoke of our unreadiness for mobilizing an army of any size or efficiency at our many vulnerable points or even at one of them.

New Telephone Plant in the Canal Zone.—A new telephone exchange has been established at Miraflores, Canal Zone, Isthmus of Panama, for use on the Pacific division of the Canal Zone. Pedro Miguel, Corozal, Ancon quarry and Balboa are connected with the new exchange, from which about fifty stations are served. Wherever possible the poles carrying the transmission lines from the Miraflores power house have been utilized in stringing the telephone circuits. Service is furnished during working hours only and but one operator is employed. It is expected to extend the service to about 100 stations, using the party-line system.

I. E. S. Nominations.—The Board of Nominators of the Illuminating Engineering Society has selected the following candidates for the offices indicated: Dr. A. E. Kennelly, Boston, president; Mr. Preston S. Millar, New York, secretary; Mr. V. R. Lansingh, New York, treasurer; Messrs. H. E. Ives, Cleveland (to represent Chicago Section); T. H. Piser, Boston, and J. T. Maxwell, Philadelphia, vice-presidents; and Messrs. F. N. Morton, Philadelphia; John C. D. Clark, Chicago, and Arthur Williams, New York, directors. The annual meeting at which the election returns will be reported will be held in New York on Jan. 13, 1911.

Opportunity for American Electric Vehicles in Germany.—A German consul reports that American electric runabouts are occasionally seen in German cities like Berlin, and are conspicuous by reason of apparent lack of domestic rivals. As this type seems to appeal to fashionable city dwellers, and owing to the ease with which it can be operated by women, he advises American manufacturers to advertise and exhibit their electric vehicles in German cities, as by doing so there would be good prospects of an exclusive and profitable trade. The *Consular Report*, Dec. 8, No. 133, goes into details as to methods for introducing automobiles into Germany.

Old Book in A. I. E. E. Library.—Brother Potamian writes to say that attention has been called by the New York *Times* to the Waldseemueller map of the world, 1507, in which the name *America* occurs for the first time, and that it may interest our readers to know that the Wheeler gift of works on electricity and magnetism from the earliest times contains a copy of Mauro's *Sphera Volgare*, the title-page of which has a globe with the name *Ametrica*, written for America. Page 57 has another globe with the name correctly spelt. The *Sphera Volgare*, printed in Venice in 1537, is one of the rarities in the library of the American Institute of Electrical Engineers.

Prize of $25 for Electrical Catch Phrase.—Acting on the suggestion that the Commonwealth Edison Company of Chicago should adopt a standard advertising phrase encouraging the use of central-station service, the advisory committee of the company has offered a prize of $25 to the employee who makes the best suggestion for such a phrase which is adopted by the company. The words "Use Electricity" were first proposed, but it was believed that this phrase does not sufficiently represent the service rendered by the central station, and the prize contest was arranged to encourage the suggestion of other ideas for the slogan. If attractive, the successful motto will be used generally throughout the company's advertisements and signs. The contest closes Dec. 31, after which the suggestions will be opened and passed upon by the judges.

$72,000 for a Gram of Radium.—Sir Ernest Cassel, the British multi-millionaire, has presented to the British Radium Institute a gram of radium which he purchased from the Austrian Joachunstahl Radium Mining Company for $72,000. The institute will use the radium in experiments on the cure of cancer.

Cahill Telharmonium for Chicago.—Plans for supplying electrical music from a Cahill telharmonium to Chicago hotels, restaurants, theaters and public institutions are being completed by a corporation of Chicago electrical men who expect to have the apparatus installed as one of the attractions of the Electrical Show, Jan. 7 to 21.

Meter Service Cost.—In acting on an application of a central station for permission to establish a minimum rate for service, the Wisconsin Rate Commission estimated that the expense to the station of maintaining a meter was 30 cents per month. The details of the case will be found elsewhere under the head of Wisconsin Commission News.

Electrical Service for Farmers.—The chairman of the Canadian Hydroelectric Commission has announced that whenever twenty farmers or more request electrical service the commission will tap a neighboring main transmission line and erect a low-tension line, the farmers to pay for the latter in instalments extending over fifteen or twenty years.

Syracuse A. I. E. E. Branch.—At the regular monthly meeting of the Syracuse University Branch of the American Institute of Electrical Engineers Mr. Saul Lavine, of the General Electric Company and a graduate of the university, presented a paper on "Switchboards for Central Stations," reviewing the history of their development. The lecture was well illustrated with lantern slides and some of the very latest types of control boards with their mimic buses were shown.

Alabama Light and Traction Association.—At the recent annual meeting at Anniston, Ala., of the Alabama Light and Traction Association the following officers were elected: President, Mr. R. L. Rand, manager of the Anniston Electric & Gas Company; vice-president, Mr. R. L. Ellis, Selma; secretary and treasurer, Mr. G. S. Emery, Mobile; executive committee: Messrs. A. F. Kersting, Mobile; J. H. Morgan, Andalusia; M. S. Sloan, Birmingham; A. H. Sparks, Jasper, and R. A. Mitchell, Gadsden.

Officers of the A. S. M. E.—The American Society of Mechanical Engineers has elected the following officers for the ensuing year: President, Col. E. D. Meier; vice-presidents, Messrs. H. H. Vaughan, E. M. Herr and George M. Brill; managers, Messrs. D. F. Crawford, E. B. Katte and Stanley Flagg, Jr.; secretary, Mr. Calvin W. Rice, and treasurer, Mr. William H. Wiley. President-elect Meier is president, chief engineer and director of the Heine Safety Boiler Company, with offices in New York City.

Contract Signed for 10,000 Additional Street Lamps in Chicago.—The contract between the City of Chicago and the Sanitary District by which the latter will take over the existing electric street-lighting plants of Chicago and add 10,000 new lamps during the next three years, making 22,200 in all, was finally signed on Dec. 3. President Robert R. McCormick and Clerk I. J. Bryan attached their signatures for the Sanitary District and City Electrician William Carroll, Comptroller Walter H. Wilson and Mayor Fred. A. Busse for the city. The details of this interesting arrangement have appeared in previous issues of this journal.

Philadelphia Electrical Exposition.—The preliminary design for the decorations of the Philadelphia Electrical Exhibition, to be held Feb. 19-25, shows a unique setting which, if well worked out in detail, should meet with much approval. The scene will be that of a parterre or formal garden under a moonlit and starlit sky. The interior walls of the building will be covered by canvas on which will be represented a boundary garden wall, with trees beyond closing in the horizon, this canvas being continuous with that of the sky. The exhibition spaces will be green-carpeted plots with garden vases containing plants at the corners and vine-clad columns at the middle of the dividing lines running parallel with the aisles, which will have a covering simulating a garden walk.

Electricity in a Tomb.—Pending the construction of a large mausoleum in Mount Auburn Cemetery, Cambridge, Mass., the body of Mary Baker Eddy, founder of the Christian Science cult, will rest in a tomb equipped with electric light and telephone service for the convenience of a guard which has been posted. Two shifts of two men each are to keep watch of the tomb continuously, day and night, until spring, when it is expected that the body of Mrs. Eddy will be placed in a permanent structure. Current for the lighting service is supplied by the Cambridge Electric Light Company and the telephone facilities are furnished by the New England Telephone & Telegraph Company. In this way the tedium of the vigil will be relieved, and immediate assistance summoned in case of necessity.

Meeting of the New York Section of the I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society held on Dec. 8 a paper by Prof. Edward L. Nichols entitled *Some Notes on the Early History of Standards of Light* was presented in abstract by Mr. A. J. Marshall and briefly discussed by Dr. A. H. Elliott. Mr. Bassett Jones, Jr., presented a profusely illustrated paper dealing with the lighting of the Allegheny County Soldiers' Memorial in Pittsburgh. Abstracts of this paper and the discussion following its presentation are given elsewhere in this issue. At the January meeting of the section papers will be presented by Messrs. P. W. Cobb and Nelson M. Black on the effects of light on the eye, and by Mr. Paul F. Bander on the effects of reflected light in differently treated interiors. Mr. Bassett Jones, Jr., will present a paper entitled *Polar Curves of Finite Line and Surface Light Sources* at the February meeting of the section. At the same meeting Mr. Henry Hornbostel will lead the discussion of the subject "Light and Architecture."

Electrical League of Cleveland.—The first annual meeting of the Electrical League of Cleveland was held on the evening of Dec. 6 at Telling's Restaurant, where a dinner was served prior to the business session. The retiring president, Mr. G. E. Miller, of the Westinghouse company, described the progress which the league has made during the first year of its existence and pointed out various ways in which its usefulness may be increased in the future, particularly along the lines of cooperating with other local organizations in discussing matters pertaining to the electrical field. The league has 105 active members with good prospects for a large increase in the immediate future, and the officers and committees to whose efforts the spirit of hearty co-operation is due are to be congratulated. Mr. H. H. Cudmore, of the Brilliant Electric Company, who was largely instrumental in organizing the league, was elected president for the coming year. The other officers are as follows: First vice-president, Mr. E. E. Noble, Cleveland Electric Illuminating Company; second vice-president, Mr. C. T. McKinstry, the Erner Electric Company; third vice-president, Mr. C. P. Billings, Allis-Chalmers Company; fourth vice-president, Mr. A. L. Oppenheimer, Enterprise Electrical Company. Executive board: Messrs. H. E. Hackenberg, National Carbon Company; G. S. Milner, the Erner Electric Company; J. T. Kermode, Cleveland Electric Illuminating Company; J. Robert Crouse, National Electric Lamp Association. Secretary and treasurer, Mr. T. P. Cagwin, the Cleveland Telephone Company. Nominating committee: Messrs. Billings, McKinstry, Oppenheimer and N. C. Cotabish, National Carbon Company, and D. Aitken, the George Worthington Company.

INTERCONNECTED ELECTRICAL TRANSMISSION SYSTEM.

Hydroelectric Installation of the Central Maine Power Company.

ONE of the chief power sources in Maine is the Kennebec River, extending from the Canada line to the Atlantic Ocean, and passing through a basin about 150 miles long, with an average width of from 50 to 80 miles. The sources of the streams forming the Kennebec are in general at elevations of from 1800 ft. to 3000 ft. above sea level, and there is a mean descent of about 9.1 ft. per mile through the portion of the river which is developed for power utilization. The importance of securing a systematic hydroelectric service in the territory centering about Augusta and Waterville led to the formation early in the present year of the Central Maine Power Company, whose headquarters are in the City of Waterville, and whose scope of operations includes public-utility supply in the Pittsfield, Burnham, Winslow, Waterville, Augusta, Oakland, Hallowell, Gardiner, Pittston, Randolph, Farmingdale, Manchester and Chelsea districts. The accompanying map, Fig. 2, shows in skeleton outline the power house, transmission line and substation connections of the system.

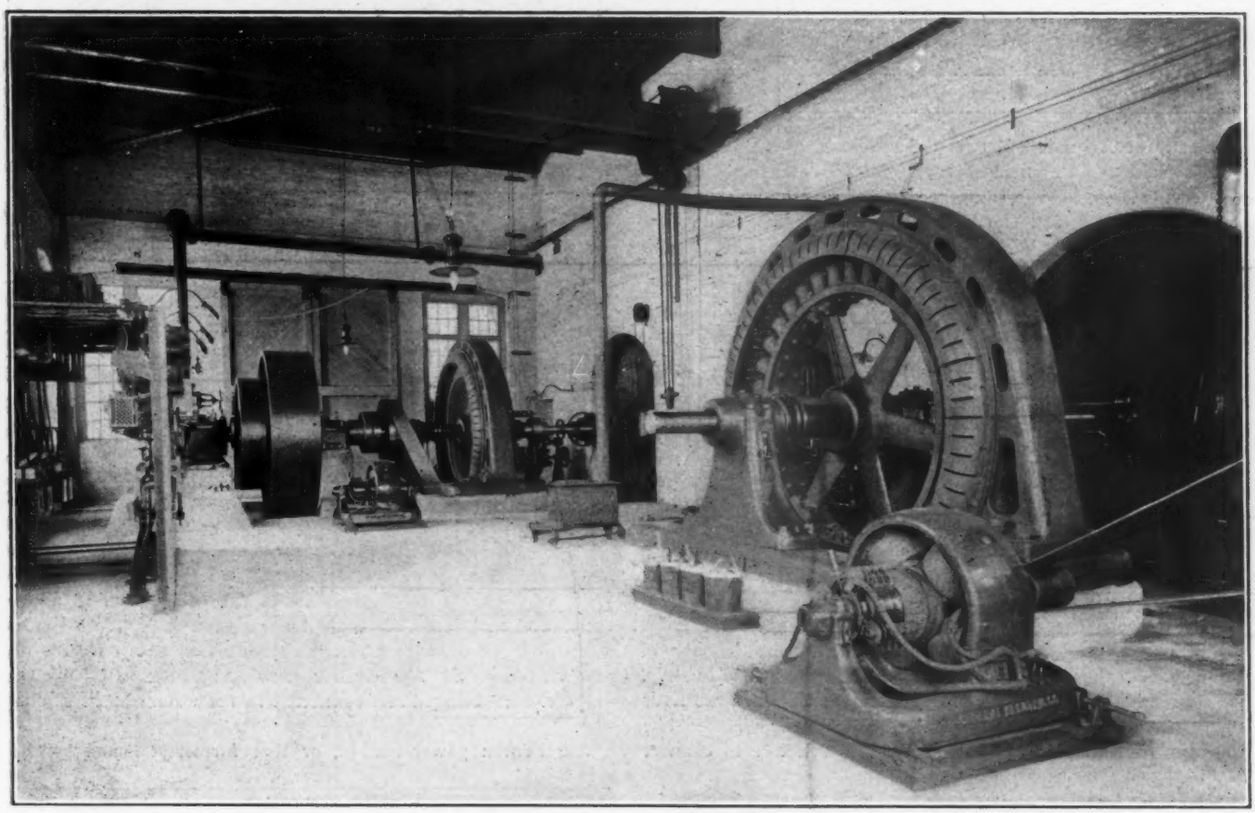


Fig. 1—Interior of Power House of Sebastian Power Company, Pittsfield, Maine.

The companies forming the Central Maine Power Company were the Fort Halifax Power Company, the Messalonskee Electric Company, Oakland Electric Company, Kennebec Light & Heat Company, Sebasticook Power Company, Sebasticook Water Power Company, Dexter Electric Company, Bingham Electric Company and Solon Electric Company. The charters under which the Central Maine Power Company is operating are perpetual, were granted by special acts of the Maine Legislature and are broad and comprehensive, the company being authorized to sell electricity for all purposes in all the cities and towns named above, with the addition of Togus, Fairfield and Benton. By the charter of the Sebasticook Power Company, the Central Maine company has the right to sell electricity for any purpose in any town within the four counties of Waldo, Kennebec, Somerset and Penobscot, except where another company is either doing business or is authorized to carry it on.

In consolidating the various properties that make up the company the management sought to secure the benefits of centralized resources, co-operative service from segregated electric generating plants and the advantages of a broader market than a single community can furnish. It was further recognized that the cities and towns in the Kennebec Valley have been built up almost entirely by manufacturing, and that future growth is to a large extent dependent upon cheap and reliable power. The present business of the company is largely under long-term contracts for street lighting, railway and private power service. A residence lighting business is also being developed throughout the territory. The company has a thirty-year contract with the Lewiston, Augusta & Waterville Street Railway Company for furnishing all its power between Waterville and Sabattus, which yields about $35,000 per year, with twenty-nine years to run. Another contract of about the same size has recently been signed with the Edwards Manufacturing Company, of Augusta. The business in the whole territory served by the company is growing faster than the company can make arrangements to supply it, and during the year 1909 more than 500 new services were added. The earnings for the year 1909 by all the companies which are now combined into the Central Maine organization were about $218,000, and it is expected that as a result of the consolidation and the development of new business in sight the income will rise to about $300,000 per year by the end of 1911.

The company controls five power plants at present and its water and steam plant possibilities are shown in the accompanying table.

The total developed generating capacity is at present 8650 hp, and the ultimate generating capacity when all the water privileges controlled or owned by the company are developed is

31,650 hp. The undeveloped water-power in Oakland is at Rice Rips and that in Clinton is at Hunter Rips, on the Sebasticook River.

The trunk-line transmission service of the system is performed by 33,000-volt, three-phase circuits connecting the Sebasticook stations with the Fort Halifax plant in the town of Winslow, across the Kennebec River from Waterville, and with the plant formerly owned by the Kennebec Light & Heat Company at Augusta. Between the Sebasticook Power Company's plant and Pittsfield a 6600-volt line is installed, between Waterville and the Messalonskee station a 4150-volt line and between Augusta and Gardiner a 10,000-volt line. The company now has about sixty-five miles of transmission lines in service between the foregoing points, about thirty-eight miles of which is the 33,000-volt line between Sebasticook and Augusta. All the generating stations are operated co-ordinately, although as little steam power as possible is used when the river stages permit full utilization of the hydroelectric plants. The company has lately been building a 15,000-volt line to connect the towns of Clinton and Dexter, a distance of twenty miles. Substations are located in Pittsfield, Burnham, Waterville, Oakland, Augusta, Hallowell, Togus and Gardiner. In general the high-tension-line spacing is 42 in. between wires, these being placed on a single insulator at the pole top and on two insulators on a short cross-arm below. The trunk line is of No. 1 B. & S. copper between the station of the Sebasticook Water-Power Company and Augusta, and of No. 4 copper between the two Sebasticook stations. Cedar poles from 30 ft. to 50 ft. long are used, and the pole spacing is usually 110 ft. The distance between the two Sebasticook stations is ten miles; between the plant of the Sebasticook Water-Power Company and Fort Halifax, seven miles, and from Fort Halifax to Augusta, twenty-one miles.

GENERATING CAPACITY, CENTRAL MAINE POWER COMPANY.

	Developed Water-Power in Horse-Power	Developed Steam-Power in Horse-Power	Undeveloped Water-Power in Horse-Power
Oakland	850	400	1,500
Pittsfield	1,200	400	
Winslow	2,800		
Benton	1,200		
Clinton			1,500
Augusta	400	1,400	
Kennebec River			20,000
Total	6,450 hp	2,200 hp	23,000 hp

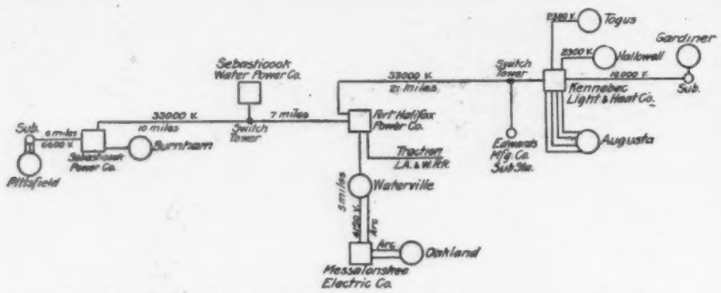


Fig. 2—Distribution System at the Central Maine Power Company.

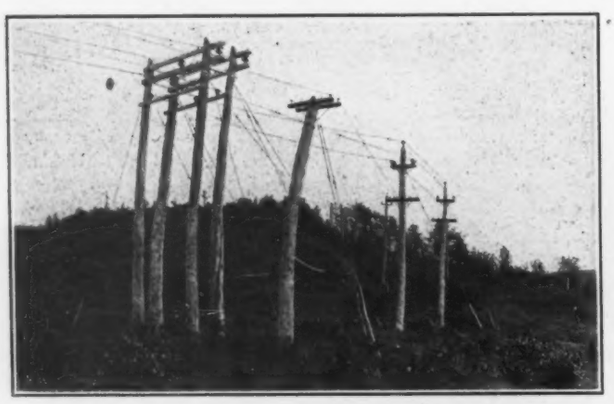


Fig. 3—Fort Halifax-Winslow-Augusta Line.

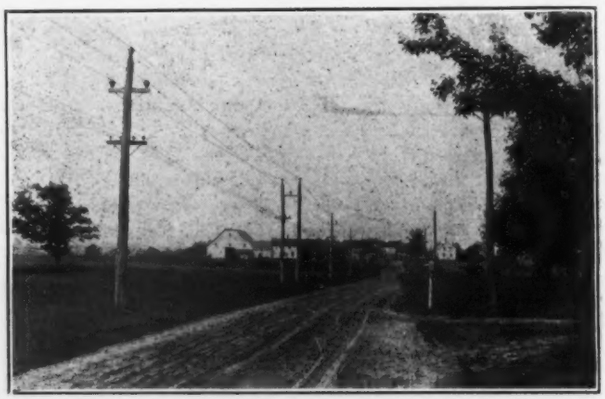


Fig. 4—Transmission Line.

The plant at Pittsfield formerly owned by the Sebasticook Power Company operates under a head of 30 ft., secured by a dam of timber construction with a full apron section, with a wasteway about 250 ft. long. The head and sluice gates are about 90 ft. long, and the distance from the foundation to the top of the spillway varies from 20 ft. to 25 ft., not including cut-off piling. One abutment of the dam is of earth construction, with a concrete-core wall about 400 ft. in length. The other abutment is of log-crib construction, about 200 ft. in length. Water is conveyed to the plant by a steel penstock 12 ft. in diameter and 500 ft. long. The electric generating capacity of this station is 1200 hp, and it delivers current to Pilttsfield via the 6600-volt line above mentioned and feeds the main transmission line to the southward with 33,000-volt service. The entire system operates on 60-cycle current. The electric generating units are four in number, each being direct-connected to the waterwheel installation.

The Benton power station, or that formerly owned by the Sebasticook Water-Power Company, is provided with a timber dam, the wasteway and sluiceway gate section being founded on solid ledge. The wasteway is 260 ft. long, with a half-apron section. The distance from the foundation of the dam to the top of the spillway varies from 10 ft. to 12 ft. The plant is supplied with water by a canal 2000 ft. long, with headgates of timber construction. The retaining walls at the power house

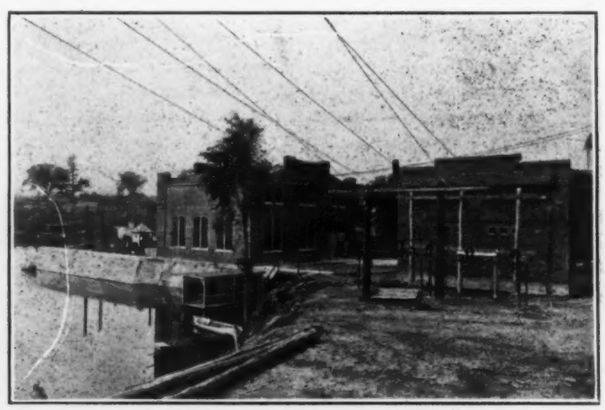


Fig. 5—Fort Halifax Power Station.

are of concrete and masonry construction, with an earth embankment and concrete-core wall. In this plant the generators are of 300-kw rating and are direct-connected to the waterwheels, the head being 22 ft. The plant rating is 1200 hp.

At the Oakland power station, which is on the Messalonskee stream, the river is never subjected to severe floods, so that the spillway is short, a large part being of natural ledge foundation, the rest being of timber and masonry construction. The

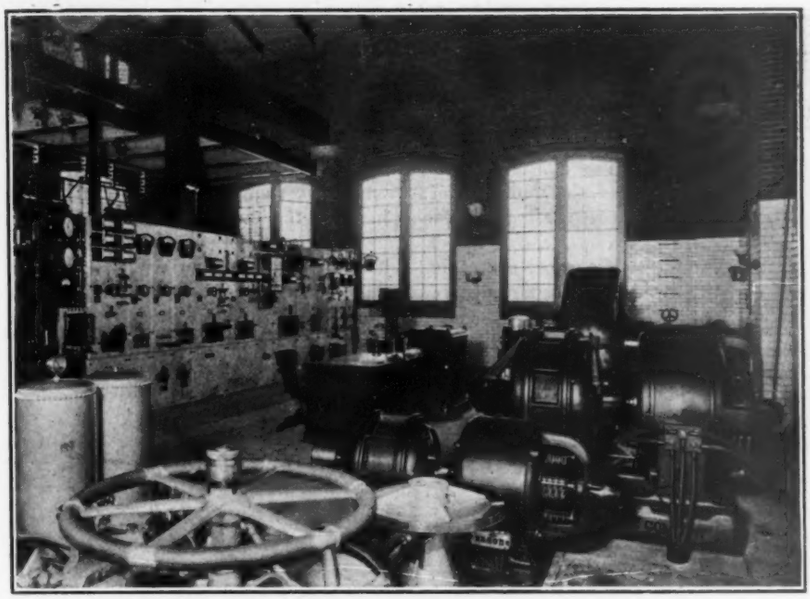


Fig. 6—Operating Room, Fort Halifax Power Station.

Messalonskee stream has a drainage area of about 200 sq. miles, 30 sq. miles of which is lake surface. This station is equipped with 1250 hp of generating apparatus driven by waterwheels and a steam-engine installation. The head on the turbines is 40 ft. The local service is handled by Stanley generators wound for three-phase four-wire supply.

At the station formerly owned by the Kennebec Light & Power Company, of Augusta, the water-power consists of a

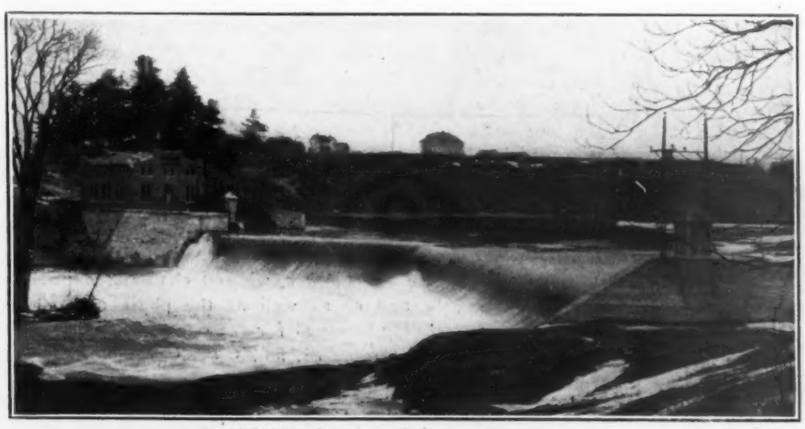


Fig. 7—Fort Halifax Power Station.

partial diversion at the local dam of the Edwards Manufacturing Company. The dam is of timber construction, 20 ft. high, and it crosses the Kennebec River a short distance above the city. About 400 hp in hydroelectric machinery is in service here, with 1400 hp in steam-driven equipment used at times of low water.

The Fort Halifax station is located on the Sebasticook River, near its junction with the Kennebec. The power house is a one-story and basement structure of brick, with concrete cornice and Ferroinclave roof. The floors are of concrete, laid on Ferroinclave. A hollow concrete dam, with a 350-ft. spillway, has been built on a ledge crossing the river at this point, with one end extending to a heavy abutment rising 13 ft. above the level of the spillway and extending well into the clay which forms the bank of the river. The other end of the dam extends into an abutment tied into a flume wall which is carried through as the wall of the generator room of the station. The dam was built by the Ambursen Hydraulic Construction Company, of Boston, Mass. The station contains two horizontal turbine units set in open concrete flumes, the walls of which are carried up to the same height as the abutments of the dam. Each hydraulic unit consists of four 42-in. horizontal turbines, each set being capable of developing 1400 hp under 20-ft. head and about 2000 hp under 24-ft. head. From the flumes the shafts of the waterwheels pass through steel bulkheads set in the wall of the generator room and connect directly to two 750-kw, 25-cycle, 400-volt generators of the three-phase, revolving-field type. One of the generating units is provided with a separate 60-cycle revolving field and armature used in local lighting and power service and acting as a frequency changer when desired to tie the railway and the Central Maine power distribution systems together. The railway company has the use of 1500 kw of the station capacity, and the frequency of its apparatus is 60 cycles. By operating the double-frequency unit the load on the station can be maintained at economical points through the parallel operation of the equipment with the plants on other parts of the Central Maine system.

The main operating room of the Fort Halifax station is located 25 ft. above the generator room to avoid danger in case of the backing up of freshets from the Kennebec River. In the operating room are located waterwheel governors, motor-driven exciters, transformer, switchboard and substation equipment. The transformer installation, which raises the line potential to 33,000 volts, is located in a fireproof house outside the main plant, and selector switches and lightning arrester equipment are installed in each circuit. The transformers for the railway service are located in the main station at one side of the operating-room floor, and these deliver current to the line at 19,000 volts for feeding the various substations on the new interurban line between Augusta and Waterville. Power is supplied by this line to substations of the railway company at Day's Corner and Webber Pond, with a lower voltage connec-

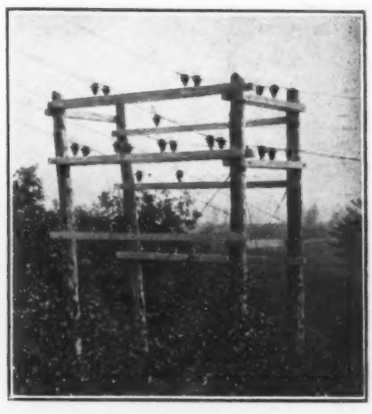


Fig. 8—Transmission Line, Junction on Fort Halifax Branch.

tion to a railway substation in the town of Winthrop. The power plant at Fort Halifax contains a 200-kw rotary converter, which supplies energy to the railway feeders and trolley in the Waterville district. The turbines in the Fort Halifax station were built by the Holyoke Machine Company, of Worcester, Mass., and the head-gate installation, divided into eight units, is raised by a 10-hp induction motor operated on a 220-volt circuit. At this station flashboards are used to a height of 4 ft. above the dam level, and the company has used manure most successfully in plugging holes in the boards. A

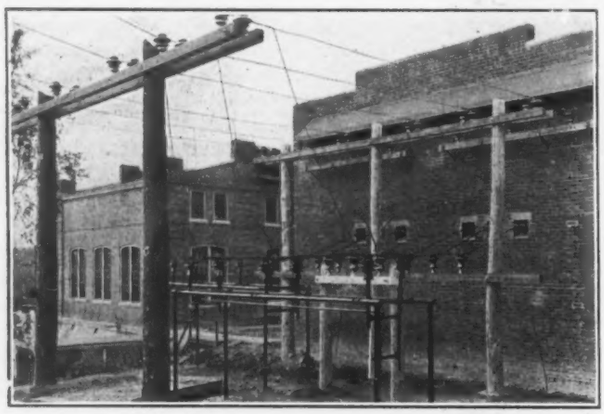


Fig. 9—Substation, Fort Halifax.

Sturtevant blower, direct-driven by an induction motor, is installed in the generator room to facilitate ventilation, the machines being so far below the surface as to require special consideration on this score. Horn-gap lightning arresters are installed in the outgoing lines outside the plant, the equipment being carried on insulators supported on an iron-pipe framing.

Among the larger power customers of the company, in addition to the railway company, are the Wyandotte Worsted Mills, Waterville; the Somerset railway shops at Oakland, the Oakland Woolen Company, the Drum Edge Tool Company and the Maine Central Railroad repair shops at Waterville. In the last-named installation about 250 hp in motors have been placed in service in sizes of from 75 hp to 5 hp, and the tools in most

Fig. 10—Fort Halifax Dam.

cases are back-geared to the motors, with individual driving in the majority of cases. A large number of woodworking concerns, sawmills and grain mills are on the company's lines.

The principal offices of the Central Maine Power Company are located at 141 Main Street, Waterville, and the officers are: President, Harvey D. Eaton; treasurer and general manager, Walter S. Wyman; vice-president, John N. Webber, all of Waterville, Maine. The directors are: Messrs. Eaton, Wyman and Webber, and in addition Messrs. George D. Hegerty, Waterville, who is also clerk of the corporation; Winthrop Coffin and John R. Macomber, Boston; Samuel C. Manley and Guy P. Gannett, Augusta, Maine; Josiah S. Maxcy, Gardiner, Maine; George F. West and James H. Kelleher, Portland, Maine; C. E. Vickery, Pittsfield, Maine, and W. M. Ayer, Oakland, Maine.

CURRENTS IN DELTA-CONNECTED CIRCUITS.

By B. F. Jacobsen.

It is customary to install three ammeters in a delta-connected circuit in order to enable the operator to ascertain whether or not the load is balanced on the three phases. The purpose of this article is to investigate the relation which exists between line currents as measured by the switchboard instruments and the currents in each phase of the delta-connected generator. Fig. 1 shows the diagram of connections and Fig. 2 the vector diagram; the capital letters in Fig. 2 denote voltages and the small letters denote currents, and the two figures are lettered to correspond. If all currents flowing toward the generator are called positive and all currents away from the generator are called negative, and all currents flowing in clockwise rotation in the generator are called positive and vice versa, it is seen that current a, which is made up of currents ab and ca, is negative when ca is positive and larger than ab; or when ab is negative and larger than ca; or when ab is negative and ca is positive. Current a is zero when ab is equal to ca. The same holds good for currents b and c.

In Fig. 2 the current vectors are positive when their projection on the vertical points upwards, and vice versa. The current vectors a, b and c must be read in the direction of the arrowheads in Fig. 2, so that b is negative, a and c positive. Whether a certain current is to be called positive or negative in a given instance is of course entirely arbitrary, but much confusion will be avoided if one will only make certain assumptions, so that a current vector shown in the vector diagram is always known to represent a current flowing one way or another in Fig. 1; otherwise the vector diagram loses its physical meaning and the vectors themselves become mere mathematical symbols.

From Fig. 2 it is seen that when the load is equally divided between the three phases ab, bc and ca of the delta-connected generator and the phase-angles Θ_{ab}, Θ_{bc} and Θ_{ca} between voltage and current are alike, then the three ammeters A, B and C, Fig. 1, connected in the leads, will each indicate alike, or $\sqrt{3}$ times the currents ab, bc or ca. In Fig. 2 $\Theta_{ab} = \Theta_{bc} = \Theta_{ca} =$ arc cos 0.8; $ab = bc = ca = 7$ amp, and $a = b = c = 12.1$ amp. It is also seen that the angles δ between the currents a, b and c in the leads and the voltages AB, BC and CA are all alike. But this is no criterion as to how the currents a, b and c are divided up between the three phases ab, bc and ca of the generator, for the center O, Fig. 2, may be shifted to any place outside or inside the triangle abc, without changing the angles δ, although ab, bc and ca as well as the phase angles Θ_{ab}, Θ_{bc} and Θ_{ca} would only be equal for the one position shown in Fig. 2. But if $ab = bc = ca$, and $\Theta_{ab} = \Theta_{bc} = \Theta_{ca}$, then the angles δ must be alike.

In Fig. 3 the line currents a, b and c have the same values as above in Fig. 2, and the phase angles $\Theta_{bc} = \Theta_{ca} =$ arc cos 0.8 as before, but $\Theta_{ab} =$ arc cos 0.997, and now $ab = 8$ amp, $bc = 9.3$ amp and $ca = 4.5$ amp. If Fig. 2 represents maximum normal load conditions with $ab = bc = ca = 7$ amp, then the conditions represented in Fig. 3 involve an overload of $9.3 - 7 = 2.3$ amp, or 32.9 per cent in one phase. This would probably not be of much consequence in the generator where the phase windings are distributed over the entire armature and the difference in heating due to I^2R losses would increase only 16.2 per cent $= (8^2 + 9.3^2 + 4.5^2 - 3 \times 7^2) \div 147$. If the copper losses in the generator at full normal load amounted to 2 per cent of the output, then the unbalance would cause an addi-

tional loss of 0.32 per cent. It would also cause some slight additional loss by distorting the field, etc. In case of delta-connected transformers the unbalance would increase the heating of one transformer 76.5 per cent $= (9.3^2 - 7^2) \div 49$. When, therefore, one transformer out of a bank of delta-connected transformers heats considerably more than the others, with line ammeters reading alike, it is known that the phase-angles Θ are not alike. The minimum generator, transformer and line losses for a given load would, of course, occur when the load is balanced on the three phases, because the losses are proportional to the square of the currents, and a given load with a given voltage means a given total amperage, or $a + b + c = I$ and $a^2 + b^2 + c^2$ equals a minimum when a, b and c are all equal.

If it can be assumed that the phase-angles Θ are all alike, the distribution of current in the three-phase windings of the generator may be determined from the readings of the line ammeters. This fact is shown in Fig. 4, where a equals 10 amp, b equals 13 amp and c equals 8 amp. A triangle is first drawn with the sides 10, 13 and 8; then on a separate sheet of transparent paper a "Y" is drawn, with an angle of 120 deg. between each of its three branches. By placing this "Y," drawn on the transparent paper, on top of the current triangle, a position of the "Y" may be found where each of the branches intersects one vertex of the current triangle. This is the correct position. The center of the "Y" is marked through on the paper below, and the lines ab, bc and ca can then be drawn in and measured. In Fig. 4 the values found are: $ab = 8.5$ amp, $bc = 6.5$ amp and $ca = 2.5$ amp. Although the maximum ratio between the readings of the line ammeters is only $b : c = 13 : 8 = 1.63$, the maximum ratio between the phase currents is $ab : ca = 8.5 : 2.5 = 3.4$.

In case, however, the phase-angles Θ cannot be assumed to be equal, the readings of the three line ammeters furnish no clue to the distribution of current in the generator. Fig. 3 shows that the line currents a, b and c may be equal and yet the currents ab, bc and ca may not be equal. Fig. 5 shows the same line currents as Fig. 4, but here the phase currents are made equal, $ab = bc = ca = 6.5$ amp.

By adding single-phase motors to a polyphase load a condition of unequal power-factors may very well be brought about, and in such cases the readings of the line ammeters should not be relied upon altogether to furnish the correct information. A diagram may, however, be drawn as Fig. 4, knowing the line currents and assuming equal phase-angles, and then the angles between the phase currents ab, bc and ca may be varied to correspond to the greatest difference in power-factors which would be likely to occur, and in that way the worst possible condition may be approximately determined.

It is evident that as long as there is no appreciable voltage distortion and with power-factors such as are likely to prevail in a commercial circuit the currents ab, bc and ca can never exceed the maximum value obtained by ammeters A, B and C. In case phase ca is disconnected, $ab = a$ and $bc = c$.

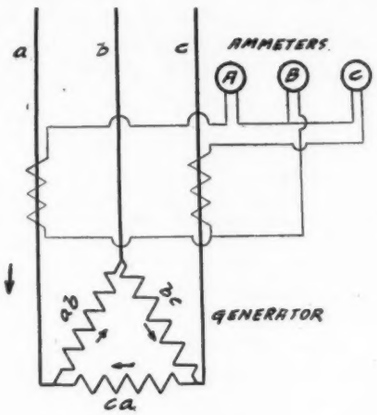
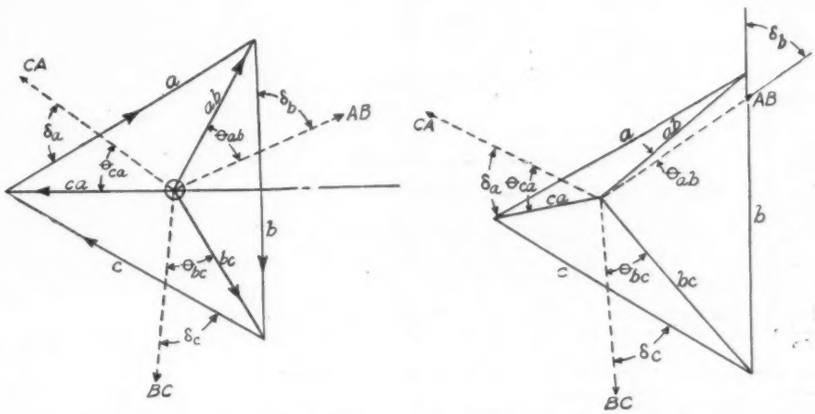
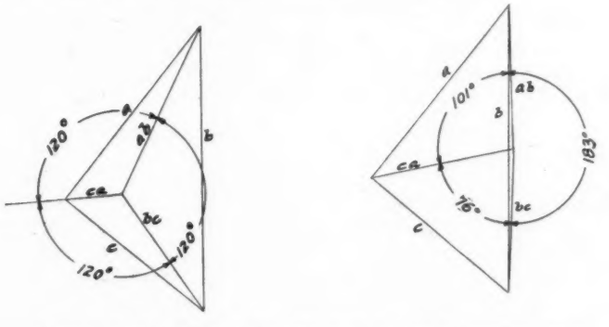


Fig. 1—Connection Diagram.



Figs. 2 and 3—Vector Diagrams of Current and Voltage Relations.



Figs. 4 and 5—Vector Diagrams of Current Components.

SOLUTION OF PROBLEMS IN STAR-CONNECTED UNBALANCED THREE-PHASE CIRCUITS.

BY CHESLEY H. JOHNSON.

The article by Mr. Harry P. Wood in the issue of the *Electrical World* for June 16, 1910, shows a short solution of some problems involving star-connected three-phase circuits. The following method of attacking similar problems may be interesting to some who are unfamiliar with symbolic equations and yet acquainted with the more usual methods of representing alternating-current vectors. Use will be made of the crank diagram, anti-clockwise vector rotation being positive; the scheme of resolving the vectors into vertical and horizontal components is used. A vertical vector is considered positive when above the horizontal axis and a horizontal vector is considered positive when to the right of the vertical axis.

It may be well to repeat the modified form of Kirchhoff's laws governing unbalanced alternating-current circuits, namely, (1) at any instant the geometric sum of the currents meeting in a point equals zero, and (2) at any instant the geometric sum of the e.m.fs. acting around a closed circuit equals zero.

For a possible direct comparison the problem outlined by Mr. Wood will first be solved. In Fig. 1 is shown a diagram of the circuit. The vector diagram may now be drawn as in Fig. 2. The line voltages, being equal and spaced 120 deg. apart, are first laid off with one vector horizontal. Some value and time position can now be assigned to the phase voltage OA as shown in Fig. 2. This choice determines the other phase voltages. In each case the phase-voltage vector is reversed, thereby completing the parallelogram with the line voltage as

the diagonal, and determining a new phase-voltage vector, which in turn is reversed to determine the third one. This construction is entailed by the fact that the line voltage represented is the vector necessary to close the polygon with the corresponding phase voltages as sides or an illustration of the law (2). The construction will be rendered perfectly clear by referring to Fig. 4. The parallelograms $OB'ZA$ and $OCZA'$ are constructed with equal diagonals OZ and side OA equal to side OA'. In order to prove the construction it is necessary

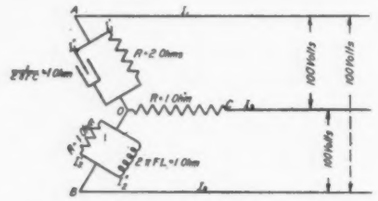


Fig. 1—Three-Phase Unbalanced Load.

merely to show that the diagonal of the parallelogram $OC'ZB$ is equal to OZ. $OC'ZB$ has as sides $OB = OB'$ and $OC' = OC$, the remaining sides of the first two figures.

In the parallelogram $\overline{OCZA'}$, $\overline{OZ}$ cos 30 deg. $= OC$ cos $\overline{COM} + \overline{OA'}$ cos $\overline{A'OM}$.

In the parallelogram $\overline{OC'ZB}$, $\overline{OZ}$ cos 30 deg. $= OC'$ cos $\overline{C'OM'} + OB$ cos $\overline{BOM'}$.

Angle $\overline{COM}$ = angle $\overline{C'OM'}$, $\overline{OC} = \overline{OC'}$ and $\overline{OA'} = \overline{OA}$.

(The projection of a diagonal of a parallelogram is equal to the sum or difference of the projections of its sides.)

Angle $\overline{SAZ}$ = angle $\overline{BOM'}$, angle $\overline{A'OM}$ = angle $\overline{SAO}$, $\overline{AZ} = \overline{OB'} = \overline{OB}$, cos $\overline{SAZ} = \overline{AS} \div \overline{AZ}$ cos $\overline{SAO} = \overline{AS} \div \overline{OA}$. $\overline{AS} = OA$ cos $\overline{SAO} = AZ$ cos $\overline{SAZ}$, substituting OA' cos $\overline{A'OM} = OB$ cos $\overline{BOM'}$. Hence OZ has the same value in each parallelogram. Another fact that may aid in the graphical construction is that the vertical components of two of the phase voltages are always equal when the line voltage vector $O-AB$ is laid off horizontal as in Fig. 2. The figure should always be drawn thus to avoid error. In Fig. 2 the vertical components of OA and OB are equal.

The phase currents, expressed in terms of the unknown

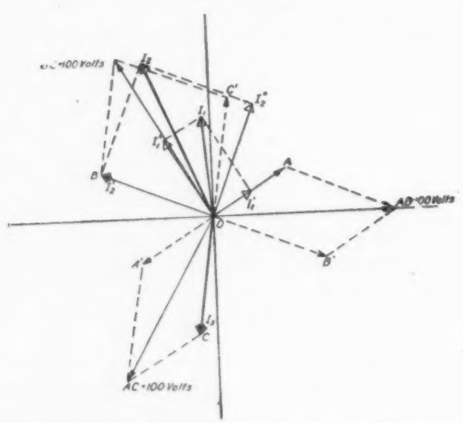


Fig. 2—Assumed Vector Relations for Fig 1.

phase voltages through the constants of the circuit, may now be laid off since their direction is known. I_1' is in time-phase with OA (non-inductive resistance), I_1'' leads OA by 90 deg. (purely condensive reactance), I_2' is in phase with OB (non-inductive resistance), I_2'' lags behind OB by 90 deg. (purely inductive reactance), I_3 is in phase with OC (non-inductive resistance). Note that due to I_1'' being 90 deg. ahead of I_1' the values of the components reverse positions if the impedance of each branch is the same, the sign of the component depending upon the position of the current vector representing it. The same principle applies to I_2''. All the quantities are resolved into vertical and horizontal projections.

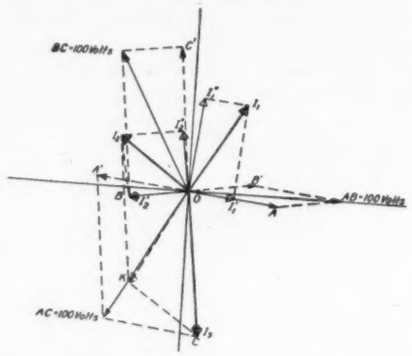


Fig. 3—Correct Vector Relations for Fig. 1.

In order to evaluate xOA and yOA utilize law (1) by putting the sum of the vertical components and then the horizontal components of I_1, I_2 and I_3 equal to zero.

Vertical components $= 0$

$$yOA/2 + xOA + yOA + 100 - xOA + yOA - 86.7 = 0$$

$$yOA = -5.33$$

Horizontal components $= 0$

$$xOA/2 - yOA + xOA - 100 + yOA + xOA - 50 = 0$$

$$xOA = 60$$

The solution shows yOA to be negative. This signifies that OA lags behind instead of leading AB as assumed. The

TABLE I.—LIST OF COMPONENTS.

Let xOA = horizontal component of OA.
Let yOA = vertical component of OA.

	Horizontal Component.	Vertical Component.	Value.
OA	xOA	yOA	60.2
OB	$xOA - 100$	yOA	40.3
OC	$xOA - 50$	$yOA - 86.7$	92.5
I_1'	$xOA/2$	$yOA/2$	
I_1''	$-yOA$	xOA	
I_1	$\frac{xOA}{2} - yOA$	$xOA + \frac{yOA}{2}$	67.5
I_2'	$xOA - 100$	yOA	
I_2''	yOA	$100 - xOA$	
I_2	$xOA + yOA - 100$	$100 + yOA - xOA$	57.2
I_3	$xOA - 50$	$yOA - 86.7$	92.5

numerical value of all quantities may now be found. The correct vector diagram may be constructed to scale as shown in Fig. 3. The e.m.f. and current vectors are plotted to the

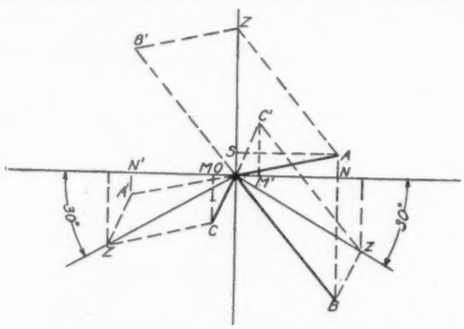


Fig. 4—Proof of Vector Relations.

same numerical scale. The method of deriving the last column in the table is that of finding the hypotenuse of a right triangle having given the two sides.

$$OA = \sqrt{(60)^2 + (-5.33)^2} = 60.2, \text{ in volts.}$$

$$OB = \sqrt{(60-100)^2 + (-5.33)^2} = 40.3, \text{ in volts.}$$

$$OC = \sqrt{(60-50)^2 + (-86.7-5.33)^2} = 92.5, \text{ in volts.}$$

$$I_1 = \sqrt{(60-5.33/2)^2 + (60/2+5.33)^2} = 67.5, \text{ in amperes.}$$

$I_2 = \sqrt{(100 - 5.33 - 60)^2 + (60 - 5.33 - 100)^2} = 57.2$, in amperes.

$I_3 = \sqrt{(-5.33 - 86.7)^2 + (60 - 50)^2} = 92.5$, in amperes.

The correctness of the solution may be checked graphically. There is the condition that $I_1 + I_2 + I_3 = 0$. The diagram must comply with this condition. Referring to Fig. 3 it is seen that OK, the resultant of I_2 and I_3, is equal and opposite to I_1, or in other words I_1 closes the polygon of which I_2 and I_3 are the other sides.

In the foregoing problem it is to be observed that the line e.m.f. is applied directly across the load. A practical variation of this problem is to consider a line drop, the generated line

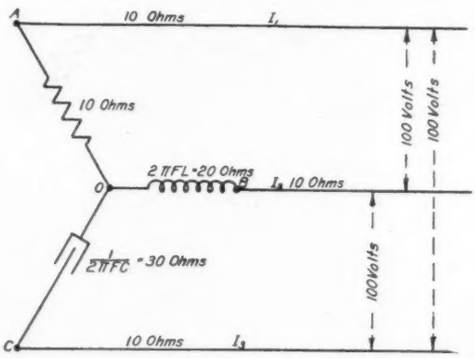


Fig. 5—General Conditions of a Three-Phase Unbalanced Load.

e.m.fs. being as before equal and spaced 120 electrical degrees apart. This problem is equivalent to an e.m.f. impressed across a star-connected load consisting of two or more impedances in series across each phase. The effect of line reactance is neglected to avoid further complication.

Fig. 5 shows a circuit containing resistance and reactance arranged so as to illustrate this problem. The line e.m.f. is

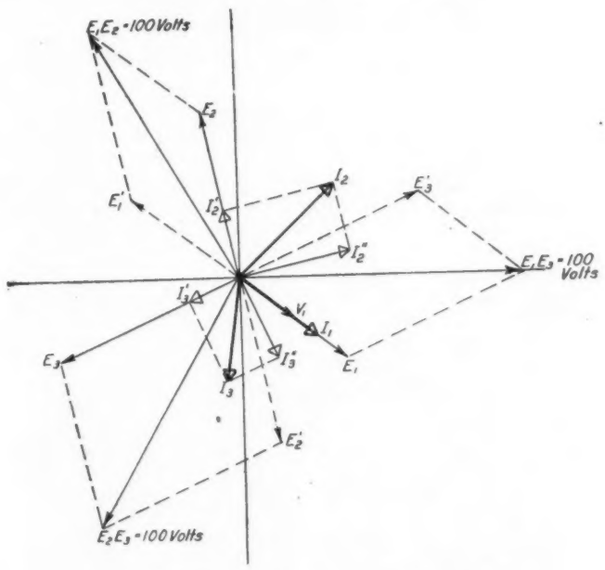


Fig. 6—Assumed Vector Relations for Fig. 5.

again taken at 100 volts for simplicity. The resistance of each wire is 10 ohms.

Let V_1 = line drop on phase 1 to point A
V_2 = " " " " 2 " " B
V_3 = " " " " 3 " " C
e_1 = vector sum of phase voltage OA and line drop V_1
e_2 = " " " " " OB " " " V_2
e_3 = " " " " " OC " " " V_3

In order to solve the problem advantage is taken of the resolution of the line current into power and wattless components. In Fig. 7 I'_1 is the power component of the current, being in phase with E; the phase e.m.f. I''_1 is the wattless component of the current, being in time-quadrature with the phase e.m.f. Cos Θ is the power-factor of the phase considered. Although I''_1 and I'_1 are fictitious currents, their consideration as currents simplifies the solution. The complexity of the problem has been increased by the addition of the line drop V_1 to the phase voltage OA, for instance, the vector sum of the two being e_1. As before, e_1, e_2 and 100 volts must form a closed polygon by law (2).

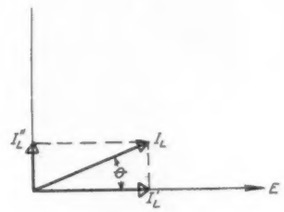


Fig. 7—Resolution of Current Into Power and Wattless Components.

Assigning some value and phase position to e_1 a diagram may be constructed similar to Fig. 6. On diagram e is shown as OE_1, e_2 as OE_2, etc. After obtaining e_1, e_2 and e_3 the current vectors may be drawn. I_1 is in phase with e_1 (non-inductive resistance); I_2 is resolved into components.

$$I_2' = \text{power component } I_2 = \frac{e_2}{\sqrt{10^2 + 20^2}} \times \frac{10}{\sqrt{10^2 + 20^2}} = \frac{10\,e_2}{500}$$

$$I_2'' = \text{wattless component } I_2 = \frac{e_2}{\sqrt{10^2 + 20^2}} \times \frac{20}{\sqrt{10^2 + 20^2}} = \frac{20\,e_2}{500}$$

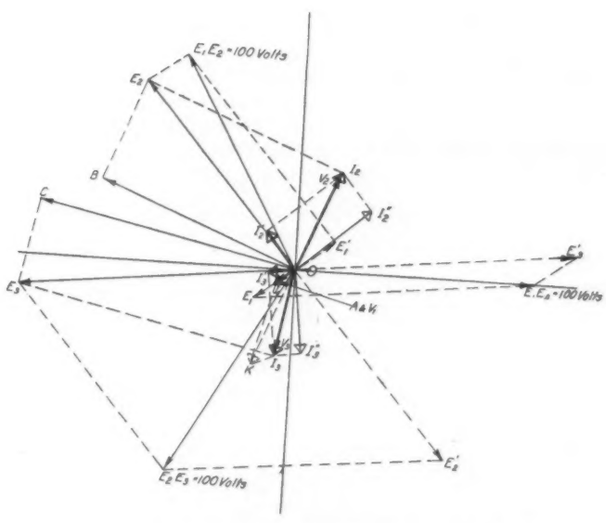


Fig. 8—Correct Vector Relations for Fig. 5.

I_2' is in time-phase with e_2 and the wattless component is in lagging time-quadrature. Note must be taken as before that the quadrature component I_2'' has its horizontal and vertical component values interchanged.

$$I_3' = \text{power component } I_3 = \frac{e_3}{\sqrt{10^2 + 30^2}} \times \frac{10}{\sqrt{10^2 + 30^2}} = \frac{10\,e_3}{1000}$$

I_3'' = wattless component $I_3 = \dfrac{e_3}{\sqrt{10^2+30^2}} \times \dfrac{30}{\sqrt{10^2+30^2}} = \dfrac{30\,e_3}{1000}$

I_3' is time-phase with e_3 and I_3'' leads e_3 by 90 deg. The line drop is in time-phase with the line current.

TABLE II.—LIST OF COMPONENTS.

Let x = horizontal component of e_1.
Let y = vertical component of e_1.

	Vertical Component.	Horizontal Component.	Value.
e_1	$-y$	x	20.4
e_2	$86.7-y$	$x-50$	100.8
e_3	$-y$	$x-100$	117.5
$I_1 = \frac{e_1}{20}$	$\frac{-y}{20}$	$\frac{x}{20}$	1.02
$I_2' = \frac{e_2}{50}$	$\frac{86.7-y}{50}$	$\frac{x-50}{50}$	
$I_2'' = \frac{e_2}{25}$	$\frac{50-x}{25}$	$\frac{86.7-y}{25}$	
$I_2 = \frac{e_2}{22.33}$	$\frac{86.7-y}{50} + \frac{50-x}{25}$	$\frac{86.7-y}{25} + \frac{x-50}{50}$	4.52
$I_3' = \frac{e_3}{100}$	$\frac{-y}{100}$	$\frac{x-100}{100}$	
$I_3'' = \frac{3e_3}{100}$	$\frac{3x-300}{100}$	$\frac{3y}{100}$	
$I_3 = \frac{e_3}{31.6}$	$\frac{3x-300}{100} - \frac{y}{100}$	$\frac{3y}{100} + \frac{x-100}{100}$	3.72

As before, there may be written $I_1+I_2+I_3=0$. Which gives the values of x and y.

Putting the sum of the vertical components of the three currents = 0,

$$\frac{-y}{20}+\frac{86.7-y}{50}+\frac{50-x}{25}-\frac{y}{100}+\frac{3x-100}{100}=0$$

$$-8y-x+73.4=0. \qquad (1)$$

Horizontal components = 0.

$$\frac{x}{20}+\frac{x-50}{50}+\frac{86.7-y}{25}+\frac{x-100}{100}+\frac{3y}{100}=0$$

$$8x-y+146.8=0 \qquad (2)$$

Solving (1) and (2) $x=-16.94$, $y=11.3$. Which shows that Fig. 6 as constructed is incorrect, the value of x being negative. Fig. 8 may now be drawn to scale, showing the correct value and direction of all quantities involved. The current scale is taken numerically ten times the voltage scale. The numerical value of all quantities, which appears in the last column of table, may now be calculated.

$e_1 = \sqrt{(-16.94)^2+(-11.3)^2} = 20.4$, in volts.

$e_2 = \sqrt{(-16.94-50)^2+(86.7-11.3)^2} = 100.8$, in volts.

$e_3 = \sqrt{(-16.94-100)^2+(-11.3)^2} = 117.5$, in volts.

$I_1 = \dfrac{20.4}{20} = 1.02$ amp. $I_2 = \dfrac{100.8}{22.33} = 4.52$, in amperes.

$I_3 = \dfrac{117.5}{31.6} = 3.72$, in amperes.

$V_1 = I_1 \times 10 = 1.02 \times 10 = 10.2$, in volts; $OA = E_1 - V_1 = 10.2$, in volts.

$V_2 = I_2 \times 10 = 4.52 \times 10 = 45.2$, in volts; $OB = \sqrt{e_2^2 - V_2^2}$; $OB = \sqrt{(100.8)^2-(45.2)^2} = 90.2$, in volts.

$V_3 = I_3 \times 10 = 3.72 \times 10 = 37.2$, in volts; $OC = \sqrt{e_3^2 - V_3^2}$; $OC = \sqrt{(117.5)^2-(37.2)^2} = 111.3$, in volts.

The construction and results may be checked graphically. Any one of the currents should be equal and opposite in direction to the resultant of the other two. On Fig. 8, OK, the resultant of I_1 and I_3, is found to be equal and opposite to I_2, thus checking the construction and calculations.

According to the results obtained voltage resonance exists in the circuit, as might have been expected from the arrangement of the circuit. The chief advantage gained by using the method outlined above is that the time-phase displacements between the various currents and voltages are shown directly.

THE SINGING-SPARK SYSTEM OF WIRELESS TELEGRAPHY.

By William Dubilier.

In the singing-spark system of wireless telegraphy as employed by the Telefunken Company use is made of the Wein principle for producing slightly damped waves. It occupies a position between the noisy transformer type of installation with its poor tuning and the noiseless undamped-oscillation system with its flame requiring constant attention.

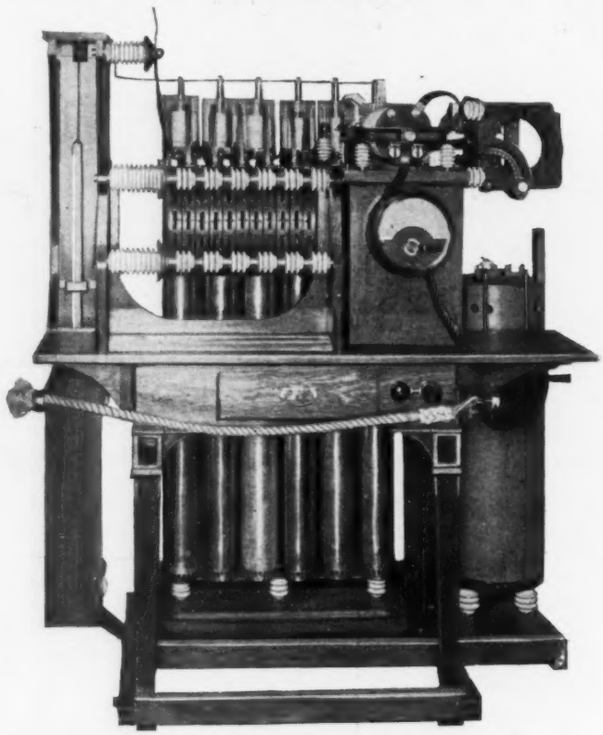


Fig. 1—Musical-Spark Wireless Telegraph Station.

A singing-spark equipment is illustrated in Fig. 1. The open-core transformer at the right increases the e.m.f. to 20,000 volts for charging the exciter condenser, consisting of Leyden jars, shown underneath the table, through an air-cooled spark-gap in series with a coupling variometer. By means of the variomter the wave-length can be adjusted at

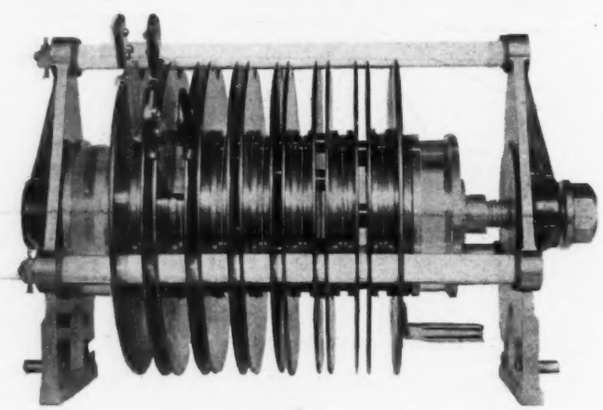


Fig. 2—Musical Spark-Gap.

from 300 m to 2500 m, the degree of "coupling" with the antenna remaining constant for all wave-lengths.

A view of the air-cooled singing-spark apparatus is given in Fig. 2. In connection with this apparatus it is to be noted that in producing quenched sparks or slightly damped oscillations a very short gap is necessary, as first discovered by Wein. When

the spark takes place, the heat evolved is soon absorbed and radiated away so that the arc rapidly extinguishes itself. In the design of the spark-gap illustrated in Fig. 2 this relation has received proper consideration and a regular sequence of the spark is obtained. The electrodes are ring-shaped with plane surfaces on the side where the spark is produced. The best results are obtained by using metal with a high heat conductivity, such as copper or silver. When a spark forms it is driven toward the periphery by means of a magnetic field, being quenched before it reaches the edge. Use is made of mica sheets between the electrodes to maintain a constant separation between them. Porcelain is used wherever possible on account of its excellent insulating qualities.

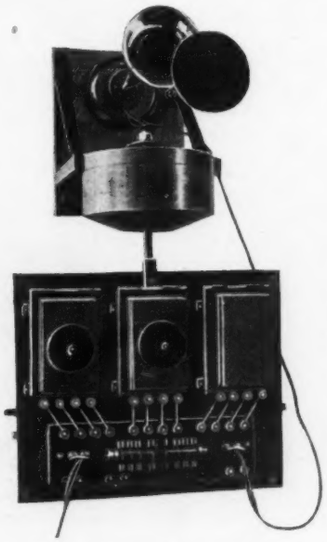


Fig. 3—Resonance Intensifier.

Where the power involved is large use is made of a number of gaps in series, the voltage being so distributed that the stress on each is kept within the permissible limit. A device is employed for short-circuiting such gaps as may not be needed in order that the power used in transmission may be varied according to the distance to be covered. Experimental observations have shown that the power consumed varies directly as the square of the number of gaps in series.

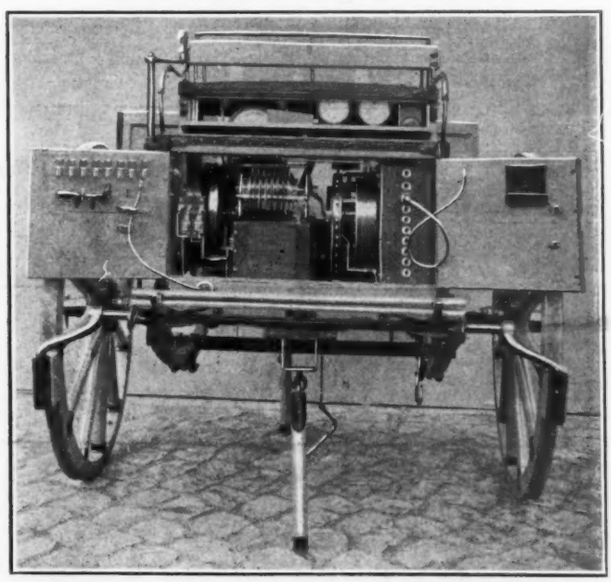


Fig. 4—Military Wireless Telegraph Equipment.

The station equipment illustrated in Fig. 1 is rated at 8 kw. When used with a T-shaped ship aerial having an effective resistance of 4 ohms the current was observed to be 38 amp, thus indicating a power of 5.8 kw at the aerial. With a consumption of 8 kw the indicated efficiency was 72.5 per cent, which is very high in view of the fact that a spark station usually shows an efficiency of about 30 per cent.

Two steamers of the Woermann line between Hamburg and the Cameroon colony fitted with the above type of apparatus communicated with each other at night over a distance of nearly 2000 miles, in spite of the fact that use was made of aerials only 120 ft. in height and 220 ft. long.

Fig. 5—Morse Recorder for Musical-Spark Apparatus.

At the receiving station use is made of the resonance sound-intensifier shown in Fig. 3. On a board balanced on an electrically damped suspension are mounted three sound resonance relays joined in series and fitted with microphone contacts. During sending the receiver is protected from the inductive action of the nearby sender by means of an automatic electromagnetic relay working in conjunction with the receiving apparatus. The employment of the intensifier makes possible the use of a loud-speaking telephone or a Morse register, such as is usually employed only with a coherer. A Morse register for this purpose is shown in Fig. 5.

The apparatus described above can be used advantageously in army service, a portable set for army use being illustrated in Fig. 4.

FLEXIBLE-TOWER CONSTRUCTION OF TAYLOR'S FALLS TRANSMISSION LINE.

A high-tension transmission line of unique design and construction is being completed from the Taylor's Falls hydroelectric plant of the Minneapolis General Electric Company into its terminal substation at the limits of the city, forty miles distant, to convey the output of two additional 2500-kw waterwheel units recently added to the existing 10,000 kw of equipment. The new transmission line parallels the route of the first line, but the feature of its construction is the use of "flexible," A-frame towers, the chief function of which is to "prop up" the line wires between the square anchor towers which are erected at one-mile intervals on the tangents.

On these straightaway stretches the A-frame prop towers are inserted at nearly 400-ft. distances, conforming to the topography of the country, and are braced erect by clamping to the ⅜-in. steel ground wire which runs throughout the line and is securely attached to the anchor towers. The construction is designed for a single circuit of three No. 0000 copper line-wires and is electrically protected by the steel ground wire at the top of the poles, which has also the structural function above mentioned.

The special A-frame towers are built of two 2.75-in. x 3.5-in. x 2.75-in. channel pieces spaced 9 ft. apart at the base and con-

verging to within 4 ft. 3 in. at the top, 42 ft. above the ground foundation. At this point a peak is formed of two smaller channel sections, carrying the steel ground cable 10 ft. above the top of the main channel legs. Against this peak triangle an 8-ft. angle-section cross-arm is bracketed on two spreaders. The pin-type 50,000-volt insulators for the two top wires of the glass insulators with cross-jumpers being used on all towers. The lowest line wire is 36 ft. above the ground at the pole.

The advantages of the A-frame on "flexible-tower" construction, which was designed by the Stone & Webster Engineering Corporation, are the decreased weight and cost per tower and the greater care with which the A-frame prop towers can be

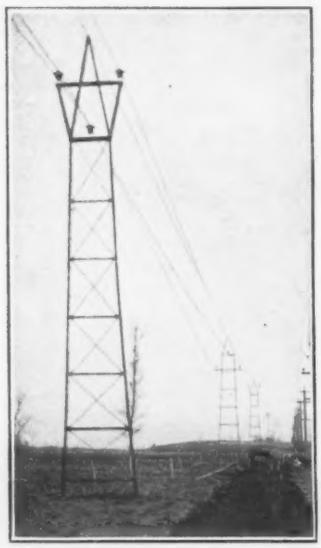


Fig. 1—Standard A-Frame Tower and Special Transportation Tower.

Fig. 2—Disconnecting Switches on Square Tower at Railroad Crossing.

Fig. 3—A-Towers with Suspension-Type Insulators.

Fig. 4—Four-Legged Anchor Tower.

inverted delta are mounted on this cross-arm, the third or bottom wire being carried through the steel work of the triangular peak structure on an insulator mounted on the A-frame cross-piece. The line wires are of No. 0000 nineteen-strand copper cable and are separated 7 ft. from each other and at a minimum distance of 5 ft. from the ⅜-in. galvanized ground wire.

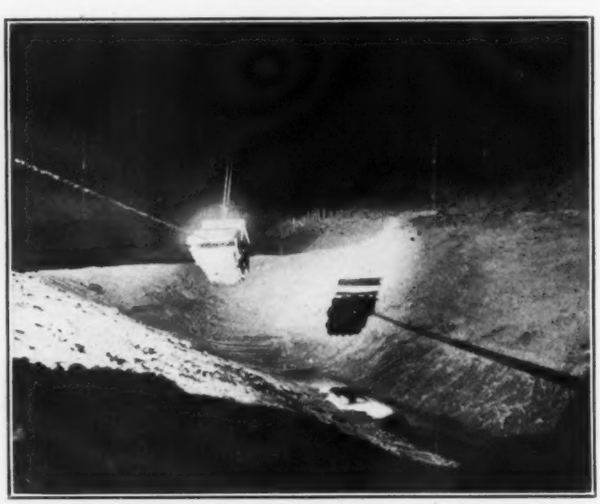
As an experiment two and one-half miles of the forty-mile line have been equipped with suspension-type insulators, as shown in Fig. 4. For this purpose the top cross-arm has been extended on each side, the insulators depending from its ends. The lower wire is carried on a suspension insulator mounted from a special cross-piece in the structure, the same distance between wires being maintained as before.

The four-legged anchor towers are of special design, arranged to receive and sustain the transmitted stresses of more than a mile of the line wires carried on A-frame towers from each direction on straight stretches. These towers are firmly anchored, but are not guyed except at sharp bends in the line. The A-frame towers were designed for taking curves up to 10 deg., but as actually installed square towers have been used at all points of curvature and wherever the spans exceed 440 ft. Special transposition A-towers are inserted at 220-ft. intervals where the transmission wires are rotated for transposing. The standard A-frame towers are not set in concrete, but are simply foundationed on inverted-T bases buried in the earth and tamped. A portion of the transmission line was carried through swamp land and here some of the towers are mounted on sections of 8-in and 10-in. pipe, some 40 ft. in length, driven down to hard strata by a pile driver and cleared of interior material by an inside worm drill.

In building the forty-mile transmission line 413 42-ft. A-frame towers were used, besides twelve 36-ft. similar towers employed at points where shorter poles were needed to conform to the elevation of the country traversed. The 42-ft. A-frame towers each weighed 2150 lb.; the 36-ft. towers, 2000 lb. There are sixty-eight 42-ft. square anchor towers, each weighing 3750 lb., and nineteen 50-ft. anchor towers, each weighing 4225 lb. The telephone circuit, which is carried on the steel cross-pieces of the tower structures, is transposed at every pole, both A-frames and anchor towers, deep-grooved erected. The Taylor's Falls-Minneapolis transmission line is the first to embody this unique principle of design in this country and will go into operation before Jan. 1. 1911.

ILLUMINATING CONTRACTOR'S BUCKET FROM HEADLAMP ON DERRICK.

In completing the Evanston Channel of the Chicago Drainage Canal, which was opened by President R. R. McCormick, of the Sanitary District, Nov. 29, twenty-four-hour excavation work



Contractor's Bucket Illuminated by Headlamp on Derrick Turntable.

in the earth section was made possible by equipping one of the derrick-operated bucket outfits with an electric headlamp mounted on the turntable so as to follow automatically the movement of the bucket in its travel from the pit to the spoil pile.

The headlamp used was of the locomotive type containing an arc rated at a mean hemispherical candle-power of 3000, without the reflector, and taking 23 amp at 32 volts. This arc was backed by an 18-in. reflector, 3 in. deep, which reflected and concentrated all the light reaching it into a slightly divergent beam cast directly under the boom from which the bucket was hung. The accompanying illustration was made from a photograph taken after nightfall with the bucket 150 ft. distant from the headlamp, and shows the area illuminated by the beam from the lamp. The lamp and case together weighed about 90 lb., and were mounted on the turntable of the crane, being rotated with it so that the light followed the bucket in all positions. When it was necessary to obtain greater diffusion of the light from the lamp the reflector was put out of focus by advancing the arc a fraction of an inch, projecting the reflected light over a large area.

Electric energy for the headlamp was obtained from a Pyle headlight turbine-generator set, capable of developing about 1 kw at 32 volts. This machine ran at 1800 r.p.m., and was fed with steam at approximately 100 lb. pressure from the temporary boilers supplying the derrick hoisting apparatus. The combined turbine and generator weighed 327 lb. Besides the headlamp, which was energized through 50 ft. of cable connecting it with the generator, the turbine set also provided energy for several incandescent lamps in the hoist cab and the boiler shed, where no central-station energy was available.

Central Station
Management, Policies and Commercial Methods

ELECTRIC CHRISTMAS PRESENT.

The Union Electric Light & Power Company, of St. Louis, distributes a brightly colored hanger showing an electric truck piled high with neatly wrapped Christmas presents, with Santa Claus at the steering wheel in charge of the load. Beneath, in a pictured wreath of holly, the company asks, "Is your Christmas gift on the electric truck? Call on Union Electric, Twelfth and Locust Streets, and make your selection." The labels and tags on the articles in the truck reveal that the jolly driver is acting as distributer for electric automobiles, Christmas-tree lighting outfits, flatirons, hair dryers, sewing-machine motors, washing machines, toasters, chafing dishes, shaving mugs, portable lamps, curling irons, coffee percolators and various forms of heaters.

NAPHTHA LAMPS REPLACED BY TUNGSTENS.

Mr. Robert J. McCuen, superintendent of the Department of Lamps and Lighting, of Baltimore, has begun the installation of tungsten lamps to replace the naphtha lamps now used in alleys where there are no gas mains. It is expected to have 600 of the tungsten lamps in service by the end of next year. There are now 998 naphtha lamps in use. Mr. McCuen finds that the incandescent lamp cost is 50 cents less per year, besides being superior in quality of service. Mr. McCuen last week prepared a report concerning the cost of lighting Baltimore streets, in compliance with a request made to Mayor Mahool by the taxpayers' committee on the city finances of Philadelphia.

RATES IN ST. LOUIS.

The Public Service Commission in St. Louis is preparing a new schedule of rates for electricity, and it is reported that the Union Electric Light & Power Company will be required to reduce its prices, whereas the company contends that the rates charged should be increased rather than decreased. Negotiations have been under way for a long time, and it is said that the matter of rates for electricity will be presented to the Municipal Assembly by Jan. 1. The commission says that rates should be based on the value of the company's tangible property, with an additional allowance for depreciation. The commission and the company find it difficult to agree as to the manner in which this valuation should be made, as to what "tangible property" is and as to what is the proper rate of depreciation. Further, the company declares that rates should be based broadly on the characteristics of the service furnished to each class of consumers, while the commission holds that, for the general good, it is expedient to modify the "cost-to-serve" principle.

COMBINATION INDUSTRIAL POWER PLANT AT WOONSOCKET.

The electric power plant above referred to is that of the Samoset Worsted Spinning Mill and the Nyanza Mill, located about half way between Blackstone and Woonsocket, which formed an independent power corporation called the Manufacturers' Power Company, in order to obtain the benefits of centralization and to avoid the wastes of separate electric generating installations. The power equipment was selected and installed according to the designs and supervision of the engineering firm of Lockwood, Greene & Company, Boston, who were the architects of the Nyanza Mill. The Samoset Mill was designed and its construction supervised by Mr. Charles T. Main, mill architect and engineer, Boston.

The power plant is equipped with six 225-hp vertical Manning boilers discharging into a Heinicke radial brick stack 200 ft. high; a 1200-kw Allis-Chalmers turbo-alternator delivering three-phase, 60-cycle current at 600 volts, and an Allis-Chalmers turbine condenser with a turbo-exciter set and a motor-driven exciter outfit. Feed, make-up and condensing water are supplied from the Blackstone River. The power house is a red-brick structure 45 ft. wide and 95 ft. long.

The motor-driving equipment in the Nyanza Mill was supplied by the Westinghouse Electric & Manufacturing Company, induction motors being used throughout. In the Samoset Mill are about fifty motors, also of the Westinghouse induction type. Each mill is provided with a separate switchboard, so that the power requirements of the different departments can be checked at frequent intervals.

BROOKLYN N. E. L. A. SECTION MEETING.

Public Service Commissioner Edward M. Bassett, of the First District, New York Commission, delivered an address on Monday evening, Dec. 5, before the Brooklyn Company Section of the National Electric Light Association at its regular monthly meeting, in the course of which he made the following broad-gage statement:

"Efficiency in a public-utility corporation redounds not only to the benefit of the public but should redound to the benefit of the corporation itself. That saving that comes from thrift, that greater earning capacity that comes from ingenuity and

faithfulness, are properly divided between the public and the corporation itself, not forgetting the payment of good wages and the making of permanent and promising positions for those who contribute for that result.

"I, for one, am of the opinion that public regulation should incite and increase and encourage private initiative. The result of thrift, economy, better results for a certain amount of work, more electricity for a certain number of pounds of coal, should not entirely, or anything like entirely, be taken advantage of by the public, for the corporation that can produce results is entitled to a large measure of the benefits of its own efficiency and progress.

"Public regulation will in no sense be a success until that principle is largely recognized, because you cannot make all companies the same. If you try to make all the same it will be pressing down the capacity to the level of the poorest rather than the raising up or the endeavor to raise up the capacity of all to that of the highest. Profit for the investor, payment of good wages and the ability to pay good wages to the workmen must be encouraged by the state, representing all the people."

President E. A. Baily, of the company section, presided at this meeting, which was attended by nearly 400 members. After the address by Commissioner Bassett two papers were presented and discussed as follows: "Notes on Power Station Economy," by Mr. H. P. Wood, and "The Follow-up System of a Purchasing Department," by Mr. H. F. Frasse. Selections were rendered throughout the evening by the Ridge Court Orchestra, composed of employees of the Edison company.

ST. LOUIS N. E. L. A. SECTION.

At the meeting of the Union Electric Light & Power Company Section of the National Electric Light Association held in the company's offices, St. Louis, Nov. 25, Mr. E. C. Freeze read a paper on "Underground Conduits and Cables," treating in a historical way the development of underground construction in connection with the distribution of electricity for the past twenty-five years. The paper described the various styles of pipe and conduits, the methods employed in placing them underground and the old two-wire Edison tube system, pointing out the advantages and disadvantages of these constructions. While tile construction has now become generally used it was shown that the use of concrete in various other building industries has been kept pace with also in conduit construction and has demonstrated its utility in securing substantial and lasting construction. The employment of concrete has gone so far as entirely to eliminate the need of any pipe whatever, thus effecting a very material saving in the cost of construction. Concrete construction was also said to give greater strength and protection against electrolytic action on cables.

The second paper of the evening was read by Mr. John F. McGlensey, illuminating engineer for the company, and was entitled "Light versus Illumination, and the Illuminating Engineer." By strong contrasting statements he made clear the difference between light and illumination. "Light," he said, "is a phenomenon; illumination is an effect produced by the phenomenon of light. Light is quantity; illumination is quality. Every central station, every lighting solicitor, every lamp salesman, fixture manufacturer, shade and reflector house are selling illumination. They are not selling so many kw-hours of electricity, so many incandescent lamps, so much light, so many shades. They are selling satisfaction, and light satisfaction is illumination." Lantern slides were employed to show the different methods of illumination, and the nomenclature, the fundamental principles, the photometric standards and the use of photometric curves were explained in detail. One of the points made in the paper, that a higher intensity may be produced at the tip of a bowl-frosted lamp equipped with a shade than with a clear lamp similarly equipped, prompted a very interesting discussion.

The St. Louis Section now has a membership of 250 and holds monthly meetings.

BALTIMORE N. E. L. A. SECTION MEETING.

Mr. T. Commerford Martin, executive secretary of the National Electric Light Association, addressed the Consolidated Gas, Electric Light & Power Company of Baltimore Section at the first of its winter meetings, which was held Dec. 6 in the physical laboratory of the Johns Hopkins University. Mr. Martin told of the comprehensive work of the National Electric Light Association, its value to the central-station industry, and gave a brief account of its wonderful growth. He recalled that twenty-four years ago in Baltimore he had addressed the second convention of the association, which was attended by a handful of people and considered a a great success. In St. Louis last summer the convention was attended by more than 2000 members.

Mr. Herbert A. Wagner, director of the electric division of the Consolidated Gas, Electric Light & Power Company and a member of the executive committee of the National Electric Light Association, and Mr. Douglass Burnett, manager of the commercial division of the Baltimore company, spoke of the importance and the value of the work to be accomplished by the company section. An active campaign is in progress to increase the membership and broaden the scope of the work of the section. Upon the initiative of the section the company has arranged for a course of ten lectures to be given by Dr. John B. Whitehead, professor of applied electricity at the Johns Hopkins University. Dr. Whitehead delivers two lectures each month, and section meetings are held semi-monthly.

The election of officers for the term of 1910-11 for the company section was hotly contested. A primary election was held at which each member suggested his choice for officers. From these votes two tickets were placed in the field. They were known as the "Progressives" and the "Insurgents." The Insurgents carried the day, although the tickets were pretty well split and both parties are represented on the executive committee. The officers elected are as follows: President, Mr. R. H. Tillman; vice-president, Mr. J. S. Cruikshank; secretary and treasurer, Mr. G. S. Colburn. Executive committee: Mr. A. W. Bull, Mr. A. S. Loizeaux, Mr. H. L. Parker, Mr. R. F. Bonsall, Mr. William Schmidt, Jr., Mr. Douglass Burnett and Mr. J. E. Hughes.

Mr. William Darbee announced the result of the election and the new president, Mr. Tillman, and the vice-president, Mr. Cruikshank, were called on for addresses. Both told of plans for an energetic, active year.

SUCCESSFUL FORTY-FIVE-DAY HOUSE-WIRING CAMPAIGN AT MOBILE, ALA.

The forty-five-day campaign for new customers among the owners and occupants of unwired houses recently conducted in a number of cities where electric lighting properties are operated by H. M. Byllesby & Company closed Nov. 15 with many new services installed and connected in each city. One of the most successful of these local campaigns was that at Mobile, Ala., where 660 houses were wired and taken on as new customers in addition to the 5000 customers already using the service in this city of 51,000 population, of which nearly 40 per cent are negroes.

In this Mobile campaign very attractive house-wiring propositions were offered. The central-station company arranged with a local contractor to make installations complete at the prices quoted below, paying him a bonus of from $2.50 to $3 for each house connected to its lines. Of course, many of the new customers wanted more complete lighting installations than were covered under the introductory propositions, and for these extras the contractor arranged his own price with the householder, deriving additional profit from this source. After the success of the campaign was assured the rest of the local contractors came into the campaign, receiving the same inducements as the original contractor.

The campaign opened with strong display full-page advertisements in the local papers announcing: "Homes Wired for Electric Light at Actual Cost: We Pay the Contractor's Profit." Three standard propositions were then set forth, it being made clear in the advertisement that the wiring done would be modern, safe and efficient, and that no agreement of any kind to use electric service would be required of the householder. The propositions were as follows:

Proposition A.—Wiring complete with lamps, $8; underwriters' inspection fee, $1; total, $9. Complete wiring for five-room house—five drop cords, five ornamental glass shades, five incandescent lamps. This will supply lighting for parlor or living-room, dining-room, kitchen and two bedrooms.

Proposition B.—Wiring complete with lamps, $10.75; underwriters' inspection fee, $1.50; total, $12.25. Complete wiring for five-room house—two two-light fixtures, three drop cords, six ornamental glass shades, seven incandescent lamps. This installation will give two lights in the living-room and two lights in the dining-room, one in each of the others.

Proposition C.—Wiring complete with lamps, $12.50; underwriters' inspection fee, $1.50; total, $14. Complete wiring for five-room house—square brass tubing fixtures instead of drop cords; wall fixtures where desired; two fixtures have two lights each, the others one. Shades richly ornamented. This gives a really artistic installation of seven lights, the lamps being included in price.

This advertisement was repeated several times and was followed up by several smaller and quarter-page advertisements explaining that the offer, which opened Oct. 1, would be withdrawn after Nov. 15. Four solicitors were employed to follow up inquiries, explain the proposition to prospective consumers and close contracts. When the forty-five-day campaign closed 660 new customers had been secured from among old houses adjacent to the company's lines, where the cost of connecting service was small. As above noted, a large proportion of Mobile's population is colored, and a number of the new installations were placed in the humble homes of the negro section of the city.

NEW-BUSINESS CAMPAIGN AND SALES ORGANIZATION AT MILWAUKEE.

The Milwaukee Electric Railway and Light Company, doing the electric lighting and railway business in the City of Milwaukee and contiguous territory, has recently undertaken a campaign for the development of its lighting and motor business. By the recent United States census the city had 373,857 population, and with the suburbs there must be a total population of 400,000. While Milwaukee has perhaps become humorously known to the majority of people as a center of the brewery industry, statistics show that in annual value of products produced beer stands fourth in the list, being lower in amount than the value of manufactured iron products, leather and packed meats.

Therefore, in such a large manufacturing center, in addition to the expectation of being able to substitute electricity for other forms of illuminants, it was anticipated that many of the industries forming the basis of Milwaukee's prosperity could be supplied with motor service. Moreover, the knowledge that electric energy could be purchased at reasonable rates would tend to attract new industries to locate in Milwaukee. It was, therefore, decided to develop this business by aggressive methods.

Several months were required in which to prepare for the organization of the new sales department of the Milwaukee Electric Railway and Light Company for this purpose, and on September 1, 1910, the organization had been practically completed and the department was in working order.

Coincident with the development of the organization of a ales department a new schedule of rates for electric light and motor service was formulated. This new schedule was designed primarily to reach the consumer having a small demand and long-hour use and the consumer using electric service in large amounts for industrial purposes. The elements of this new rate system have been discussed in the Wisconsin Commission News in the columns of this journal, and its main features are given below:

A standard rate to customers signing the standard form of contract, providing for service for a year or more, is based, first, on a demand charge, and second, on an energy charge. The demand charge, which is payable in equal monthly payments, is $42 per year for each kw of demand for the first 10 kw; $30 for the next 50 kw, and $24 for each kw of demand in excess of 60 kw. The energy charge is 5 cents per kw-hour for the first monthly 100 kw-hours consumption; 4 cents for the next 900 kw-hours; 3 cents for the next 3000 kw-hours; 2 cents for the next 6000 kw-hours, and 1½ cents per kw-hour for all energy consumed in any month in excess of 10,000 kw-hours. These rates apply to all customers receiving lighting service and free renewals of lamps.

For power service these rates, less ½ cent per kw-hour, apply to all customers utilizing service for the operation of electric motors for any purpose and who do not receive free lamp renewals.

For a limited or off-peak service a reduction of one-half the demand charge is made, on condition that the service shall not be used during a certain time of the day from October to March. In each month the end of this period is 7.00 p. m., the beginning being for the six months respectively: 5:30, 5:00, 4:30, 4:40, 5:20 and 6:00 p. m.

There is also a "ten-seven" service, which applies to customers utilizing the company's service only during the hours from 10:00 p. m. to the following morning at 7:00 a. m. For this service only one quarter of the demand charge is made.

Under the head "Maximum rate for service, and minimum payments," the conditions are that the maximum rate of charge for service during any month shall not be greater than the rates for service that would be obtained under the existing instrument rate schedules, with a prompt payment discount of 5 per cent upon bills paid within ten days after their respective dates. Rates under this schedule for lighting service range from 12 cents per kw-hour for the first 100 kw-hours during any month to 10 cents for the second 100 kw-hours; 8 cents for the third 100-kw hours; 6 cents for the next 300; 4 cents for the next 14,400; 3½ cents for the next 15,000, and 3 cents per kw-hour for all energy in excess of 3000 kw-hours per month. For power service the rates are 8 cents per kw-hour for the first 100 kw-hours per month; 6 cents for the second 100 kw-hours; 5 cents for the third 1000 kw-hours; 4 cents for the next 300 kw-hours, and 3 cents for all energy in excess of 600 kw-hours during any month. Minimum monthly payments are the monthly instalment of the annual "demand charge," provided that this payment in any instance shall not be greater than the minimum charge made under the existing schedule, namely: For lighting a minimum payment of $1, and in addition thereto 25 cents for each Nerntz lamp glower installed, and $1.50 for each arc lamp installed; and for power service, a minimum charge of $2 for an installation of 2 hp or less, and $1 in addition thereto for each hp or fraction thereof in addition to the first 2 hp. The provisions for minimum monthly payments are applicable under all rates.

The measurement of demand is determined as follows for different classes of service: For commercial lighting purposes the demand in installations of 1 kw or less is 100 per cent for the first 300 watts connected, plus 66 2/3 per cent of connected load in addition to the first 300 watts, except where tests indicate the demand to be larger than that computed on this basis. In installations of greater than 1 kw connected the actual demand shall be measured. For power service the demand of the consumer is the maximum rate at which energy is used for any continuous period of fifteen consecutive minutes as shown by a watt-hour meter.

There is a separate schedule for residence lighting service, under which customers contract for service for one year or more with free lamp renewals. There is a primary charge of 12 cents per kw-hour for the first 4 kw-hours consumed per month for each of the first four active rooms, and for the first 2½ kw-hours consumed per month for each of the active rooms in addition to the first four. All rooms are counted active except three bedrooms, bathrooms, basement, garret closets and back porch. The secondary charge for residence lighting is 5 cents per kw-hour for all energy in excess of that paid for at the above primary rate up to a total of 100 kw-hours, and 4 cents per kw-hour for the next 900 kw-hours.

The company will sell flat-rate display lighting on yearly contracts on the basis of use from dusk to 11 p. m. or 12 midnight. The rate varies from $3.35 to $3.80 for 300 watts; $10.65 to $11.90 for 1 kw; $39.65 to $44.55 for 4 kw, and $92.25 to $101.40 for 10 kw. These flat rates include renewal of carbon-filament lamps and no other maintenance.

A discount of 5 per cent is given for prompt payment of bills on the first $25 of all bills, and 1 per cent on amounts in excess of $25. These discounts apply only where the 5 per cent provided for in existing increment rate schedules is not given.

There is also a short-time lighting and power rate to customers obtaining service for periods of less than one year. For free renewals the company supplies carbon-filament lamps of 2, 4, 6, 10 and 16 cp, the first mentioned for sign and decorative lighting only, and graphitized filament lamps of 40 cp.

In formulating the foregoing schedule of rates the company had in mind the following principles:

1. A rate schedule should follow as closely as a relatively simple rate can the law of variation of cost to the company of the production and distribution of electric service.

2. A rate schedule should, if possible, cover the entire field of electric service supply from commercial and residence lighting to night storage-battery charging in garages and the supply of "breakdown" or emergency service.

3. A rate schedule should, if possible, permit the supply of lighting and motor service through the same meter, so as to reduce the expense of supplying service to customers.

4. A rate schedule should be no more difficult to apply than the Wright two-rate schedule used by the large central stations.

5. A rate schedule for residence electric service should permit the use of domestic apparatus, such as cooking and power appliances, at a sufficiently low rate to encourage such use and at the same time yield a reasonable return on the company's investment.

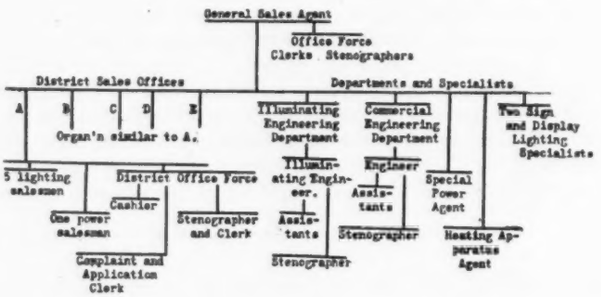
While the "new-residence lighting schedule" appears to differ from the "standard" rate, it is really a combination of the standard rate and the maximum-energy charge under the former increment-rate schedule.

The universal application of the new rate exclusively would increase many consumers' bills, which would not be permitted under the public-utility law of Wisconsin except after a hearing and decision by the Railroad Commission. The former increment-rate schedules were accordingly permitted to remain as the upper limit of charge for service under the new rate.

The City of Milwaukee contains a number of important business centers detached from the central business district. These detached business centers derive their trade from the tributary residence districts which are to a large extent more or less independent of the central business district. The city, in fact, presents the appearance of several small cities grouped around the principal center. To better reach the possible business, for the sales department's purposes, the area of the city has been divided into three districts, central, north and south, the last two to be in turn divided into two districts each when business shall have so increased in these territories as to warrant such subdivision. In quarters as near the geographical and business centers of these north and south districts as the limitations of suitable ground-floor room would permit district offices have been established. The district office for the central district is located with the general sales office itself in the Public Service Building in the heart of the downtown district. The district offices and staffs are each in charge of district sales agents, who report to the general sales agent. Under the latter's direction at the general office are stationed illuminating and commercial engineering staffs, a special motor-service agent, and heating-appliance, sign and display specialists. The arrangement of this organization as originally proposed and as followed as nearly as the personnel would permit is shown in the accompanying diagram. For each of the three district offices already organized the arrangement is in general similar to that shown under A.

The general sales agent, of course, has general jurisdiction over the work of the entire organization, and besides directing the work of the whole department visits the district offices, assisting the district sales agents. The district sales agents are instructed to rise above mere office routine and to make themselves active personal forces in their respective communities. They are advised to cultivate the acquaintance of customers, probable customers, and the men of local prominence, and to take part in local activities and improvements. The offices are rendered attractive with brilliantly lighted display windows containing household electrical devices and other applications of electricity.

Each district agent has his staff of lighting and motor-service salesmen. The duties of these salesmen, as explained to them, are (1) to secure new customers; (2) to increase the consumption of present customers; (3) to establish harmonious rela-



Organization of Sales Department of Milwaukee Electric Railway and Light Company.

tions between the company and the public, and (4) to secure business now rendered by competing services—gas, gasoline, steam engines, etc. A point is made of the third item, as it is especially desired that each customer shall feel that he has a friend within the company's organization who is ready to assist him in his electrical problems. The salesmen are also instructed to familiarize themselves with the ranges of individual customers' bills. Conferences between the soliciting staff and district heads are held daily, benefiting the men through each other's experiences and inspiring in them the enthusiasm which counts so largely in this work.

The illuminating-engineering department's duties are to improve the lighting in existing installations and to draw plans for new installations, embodying in its suggestions the latest methods of scientific illumination. This co-operative service is offered gratis to both customers and architects, and part of the advertising campaign in the daily newspapers which accompanies this new-business campaign is devoted to explaining the broad basis on which the company offers the services of its illuminating experts. Personal letters have also been written to the architects acquainting them with the free assistance they may have in designing the illumination of buildings on which they are at work. The results of the work of this illuminating-engineering department have been especially satisfactory to the customer, architect and electric company. The illuminating-engineering department is also equipped to do testing and is charged with obtaining practical data on lighting installations.

The commercial-engineering department occupies to the local field of the motor-service and steam-heating business the same expert consulting position as does the illuminating-engineering department in the electric lighting field. The commercial engineer and his staff make tests, acquire data and make reports on the operation of private plants covering the advantages and economies of purchased energy. They also study special factory operations with a view of equipping these with motor drive, designing and superintending the installations of machinery when desired. The heating-appliance agent makes a special study of the various electric heating and cooking devices on the market and indicates ways for securing the maximum satisfactory use of these by customers. The special motor-service agent's duties are chiefly to assist the district agents when necessary in meeting difficult or important situations, as the superior experience of the special agent will give him the advantage in marshaling arguments in important cases. The sign-lighting and display agents confine themselves to decorative lighting, encouraging the use of electrical displays of all kinds and suggesting special signs and electrical decorations to local merchants.

Coincident with the campaign of personal solicitation taken up by the new sales department of the Milwaukee company newspaper advertising has been used freely and effectively. Quarter-page spaces are used in each of the English, German and Polish papers, presenting strong illustrated "copy."

The present campaign has been in progress only since Sept. 1, but already satisfying results have been accomplished. In all, about fifty people are employed in the new sales department, not including special agents and salesmen associated with the large electrical companies who devote their entire time to increasing the central-station company's lighting business, at the same time aiding in the sale of their employer's products.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, has been appointed general sales agent of the company and has charge of the campaign being undertaken by the new department. Mr. Egbert Douglas, as commercial engineer, has charge of the commercial and illuminating engineering departments. Mr. A. H. Sikes is the district sales agent in charge of the central district; Mr. O. H. Kruse is in charge of the north district, and Mr. P. B. Schuster of the south.

Wiring and Illumination

ORNAMENTAL TUNGSTEN LIGHTING AT ROCHELLE, ILL.

The City of Rochelle, Ill., has just installed a system of ornamental tungsten street lighting, comprising seventy curb standards, each carrying three 60-watt lamps inclosed in frosted-ball globes. The posts are erected at 80-ft. intervals and cost $55 each complete with lamps and wiring. The cost of the installation was shared equally between the merchants whose stores were benefited and the city, the latter devoting a special-lighting fund derived from the saloon tax to this purpose. Energy for the operation of the system of street lighting is furnished by the city electric plant, and the increased demand made it necessary to purchase a new 150-kw Fort Wayne generator driven at 600 r.p.m. by a 200-hp Bates engine. The installation of the posts was made by Mr. E. R. Taylor, of Rochelle.

Ornamental Tungsten Street Lighting in Rochelle, Ill.

BRITISH MUNICIPAL ELECTRIC WIRING BILL.

A measure introduced into the British Parliament is intended to confer upon local authorities owning electric supply powers the statutory right to engage in the wiring of premises for electric light and in the sale of electrical apparatus and fittings. The bill is being promoted by the Incorporated Municipal Electrical Association, a body formed by municipal electrical engineers and members of various municipal electricity committees.

The main opposition to the bill comes from the Electrical Contractors' Association, and is based on the contention that municipal wiring and sales departments will constitute unfair and unnecessary rate-aided competition with an established branch of retail trade. The electrical contractors will be supported in their opposition by associations representing hardware dealers, and also by various taxpayers' associations and trade-defence organizations which have declared themselves in favor of the proposed legislation.

THE LIGHTING OF THE ALLEGHENY COUNTY SOLDIERS' MEMORIAL.

In a paper presented before the New York Section of the Illuminating Engineering Society on Dec. 8 Mr. Bassett Jones, Jr., described in detail the architectural features and illuminating equipment of the Allegheny County Soldiers' Memorial in Pittsburgh, which is said to be the most beautifully illuminated building ever constructed.

The author said that the structure is an imposing pile of majestic proportions in many ways reminding one of the famous tomb of Halicarnasus. The style of the exterior architecture is distinctly classic but is strongly infused with the personality of the designers.

In addition to entrance foyer and three side corridors, which completely surround the building and are illuminated according to methods representing the most advanced of standard modern practice, the building contains a main auditorium and a banquet hall which are lighted by unique combinations of practically all characteristics of electrical illuminants.

The main auditorium, which is illustrated in Fig. 1, is a large room 120 ft. clear span in the square and 65 ft. from the center of the floor to the ceiling. The floor slopes to a stage at the rear. A large gallery extends around three sides of the room. The ceiling of the auditorium is broken into panels by deep plaster soffits covering the bottom chord of the trusses which support the floor of the banquet hall above. These panels are suspended from the steel work in the banquet-hall floor and are thus only indirectly supported by the trusses. Each panel is entirely separated from the soffits by a slot 6 in. wide, and thus hangs free within the frame formed by the projecting trusses. The depth of these trusses, 12 ft., made it possible to obtain a clear space above the panels 6 ft. high which was used in the illumination of the auditorium.

The banquet hall is 35 ft. from floor to ceiling and is 74 ft. square. The ceiling is divided into forty-nine square coffers, about 2 ft. deep, the top of each coffer consisting of a decorative glass sash. The ceiling construction is hung from the steel work supporting the huge pyramidal roof above. Referring to

Fig. 2, it will be seen that a gallery extends entirely around the upper portion of the hall. Under the floor of this gallery on each side of the hall are the corridors giving access to smaller offices, meeting-rooms, kitchens, etc., along the outer wall of the building.

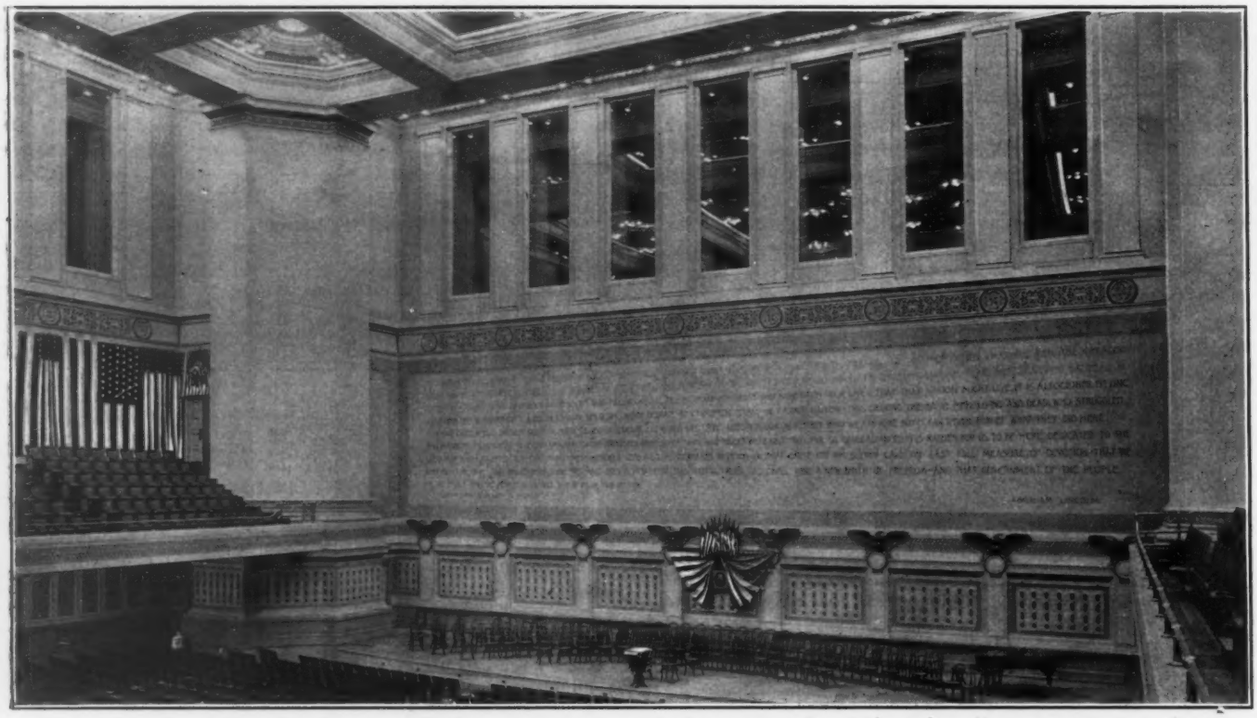


Fig. 1—Night View of Auditorium from Rear Gallery.

LIGHTING OF THE AUDITORIUM.

In Figs. 3 and 4 are given illustrations of the auditorium ceiling. The view of the ceiling, which is the principal architectural feature of this room, could not be obstructed and hence in any case the use of hanging lighting fixtures had to be avoided. The treatment of the ceiling centers around the light centers, which are also architectural centers when the room is lighted by daylight from without. These nine centers consist of circular panels of rich pierced plaster ornament, above each of which are suspended two 18-amp flame-arc lamps, so located and equipped as to cause the plaster lines to stand out in bold relief against a brilliant flickering background. The general effect is that of a scintillating jewel of intricate pattern. One of these circular panels forms the central feature of each of the large panels into which the entire ceiling is divided by the deep beam soffits under the steel trusses supporting the floor above.

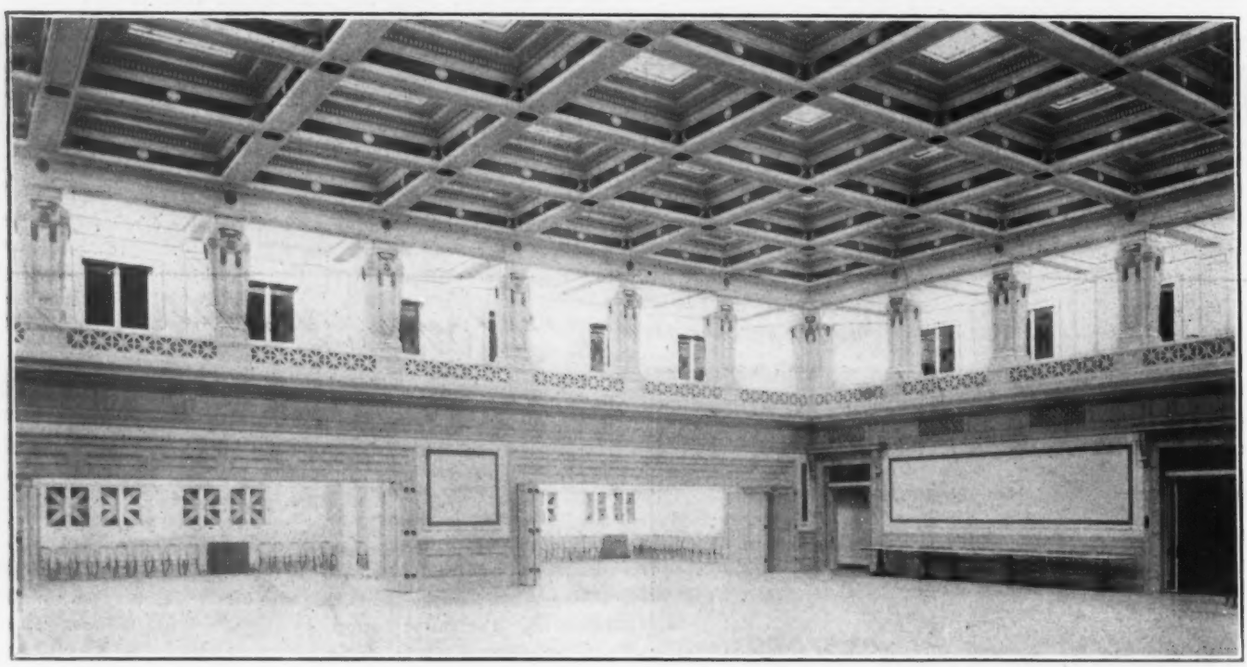


Fig. 2—Night View of Banquet Hall.

A group of glass sashes is arranged around each of the flame-

arc panels and forms a design of geometrical surfaces broken up into small figures by the sash frames. A box reflector is placed over each sash.

Each of the main rectangular panels, consisting of a flame-arc center and its group of sashes, is framed by a concealed nitrogen-vapor tube lamp provided with a reflector that projects the light through a slot entirely surrounding the panel. Each panel is thus bordered by a band of rose-colored light.

The ornamental plaster mullions separating the sashes in each panel are provided with plaster rosettes equipped with exposed incandescent lamps employed to accent architectural features and show off the elaborate decorative treatment of the plaster work

Glass panels are located close to the side walls one over each window and over each is provided a parabolic reflector containing a 400-watt mercury-vapor lamp. The light from these lamps is directed against the walls of the room and through the windows and is so modified by the glass in the panels as to acquire a pale, sky-blue tone.

The lighting of the auditorium is controlled by switching devices in a closet off the stage so that any feature of the lighting may be turned on or off at will. It is intended that either the light from the glass sashes or the light from the exposed lamps under the ceiling will be sufficient for ordinary purposes, while the entire lighting system will be used only on special occasions.

The cost of installing the auditorium lighting was remarkably low, as the cost of fixtures appropriate for lighting this immense room would have almost equaled the cost of the present illuminating equipment of the entire building.

In Fig. 5 is given a view of the building during construction showing the trusses for supporting the banquet hall. These trusses are 12 ft. deep and provide excellent space for containing the equipment for lighting the main auditorium. Fig. 6 indicates the method of installation of the mercury-vapor lamps. The reflectors were arranged so that each lamp trough and its diffusing equipment could be lifted bodily out of the reflector. Unfortunately certain unexpected difficulties were met in the installation which required further changes after the reflectors for this room were delivered. The reflector walls are generally perpendicular instead of sloping, which somewhat cut down the efficiency of the device.

The nitrogen-vapor tube lamps (Fig. 7), mercury-vapor lamps and flame-arc lamps are used solely for effect, efficiency not being considered, since the particular effect desired could not be obtained in any other way. To use incandescent lamps with color screens in place of nitrogen tubes and mercury arcs would require the use of very expensive screens of special burned glass without any certainty that any one melt would have produced the correct tint. Furthermore, the exact character of light required cannot be attained by any such method. Of course, no substitute can be found for the flame-arc lamps that will give a scintillating flux.

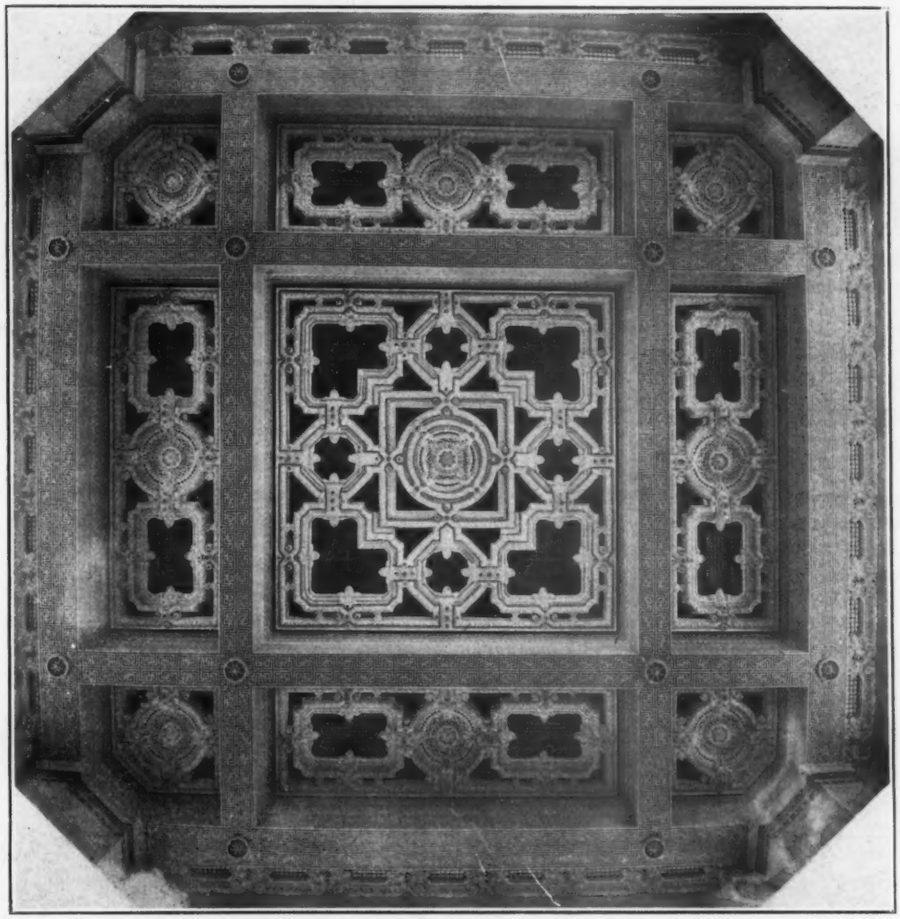


Fig. 3—Auditorium Ceiling by Daylight.

The smaller sashes of irregular pattern (see Fig. 3) were left open to the space above the ceiling and are lighted in an irregular manner by the flame-arc lamps, thus relieving the ceiling from a monotony that it would otherwise have exhibited. The amber glass in these sashes has the appearance of burnished copper when lighted. Some interesting effects have been obtained by covering a few of these sashes by thin developed blue-print paper, the two tints transposing the light transmitted from the flame arcs into an exquisite pale green.

Some difficulty was experienced with the pierced plaster grilles under the flame-arc lamps because the contractor for the plaster work had made the castings too thin. After some experimenting the grilles were covered above with thin cheesecloth which prevents the construction of the ceiling from being

seen. The cheesecloth is entirely disguised and gives a solid appearance to the grilles.

Frosted-tip tungsten lamps were first used in the rosettes under the ceiling, but the great intrinsic brilliancy and excessive whiteness of the light from these lamps when contrasted with the generally soft yellow tone of the rest of the illumination produced unfortunate results, and with the exception of the

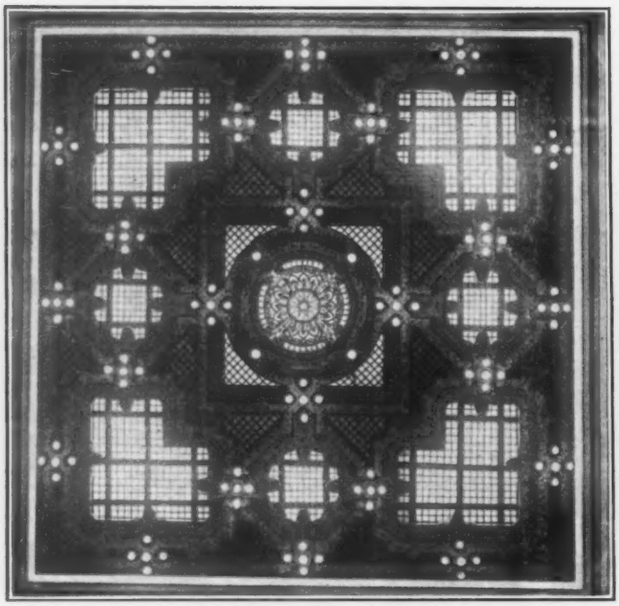


Fig. 4—Part of Auditorium Ceiling at Night.

center lamp in each group they were replaced with 8-cp frosted-bulb carbon-filament lamps.

Thirty different effects can be obtained in the lighting of this ceiling, all of which are interesting. The most remarkable effect is obtained by using only the nitrogen-vapor lamps and flame-arc lamps. The ceiling then appears like a huge decorative grate above which great fires are burning. The maximum intensity on the floor then reaches 0.7 foot-candle. Adding the

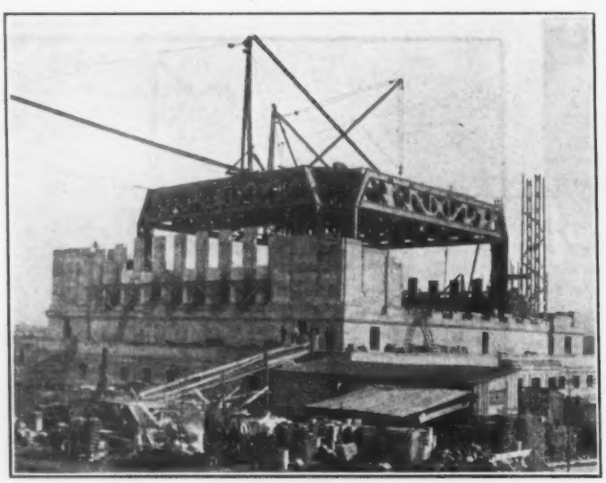


Fig. 5—View During Construction, Showing Trusses for Supporting the Banquet Hall.

mercury-vapor lamps to this combination does not change the illumination on the floor, due to the form of the reflectors used with these lamps, but the effect produced is most weird and profoundly alters the color of the walls to a gray-blue. The light from the nitrogen-vapor lamps so completely detaches the panels from the ceiling that they appear actually to float in their frames and the slight flickering of the light that sometimes occurs seems to set them moving.

The maximum intensities of illumination on the floor for different combinations were as follows: All lamps in use, 3.82 foot-candles; exposed incandescent lamps and sashes, 3.10 foot-candles; sashes only, 1.46 foot-candles; exposed incandescent lamps only, 1.74 foot-candles; nitrogen tubes only, 0.40 foot-candle; flaming-arc lamps only, 0.30 foot-candle.

The above readings were taken directly after the work was completed and with a large amount of accumulated dust and dirt on the sashes. The results are, therefore, the worst that

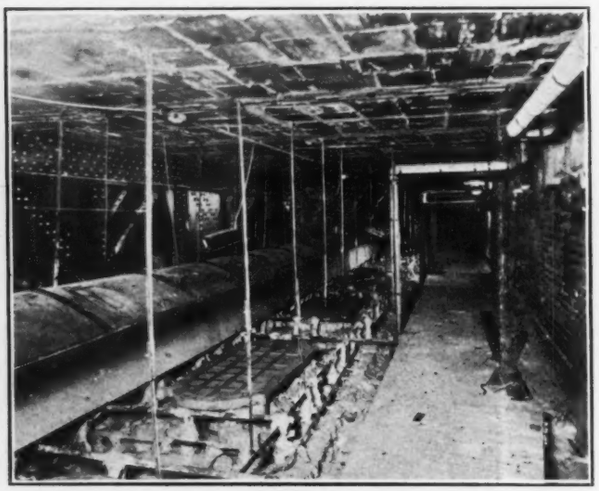


Fig. 6—View Above Auditorium Ceiling, Showing Mercury-Vapor Lamps and Reflectors.

can be obtained, since once the sashes are cleaned the box reflectors will prevent any serious lowering of the intensity due to a similar cause. The loss due to dirt amounted to at least 20 per cent of the lamp flux.

The power consumption per square foot of floor area is: for the sashes, 4.03 watts; for the exposed incandescent lamps, all tungsten, 1.20 watts, and for part 8-cp carbon lamps, 1.14 watts. The total power "let loose" above this ceiling, including the exposed incandescent lamps, amounts to 117.20 kw with all lamps in use.

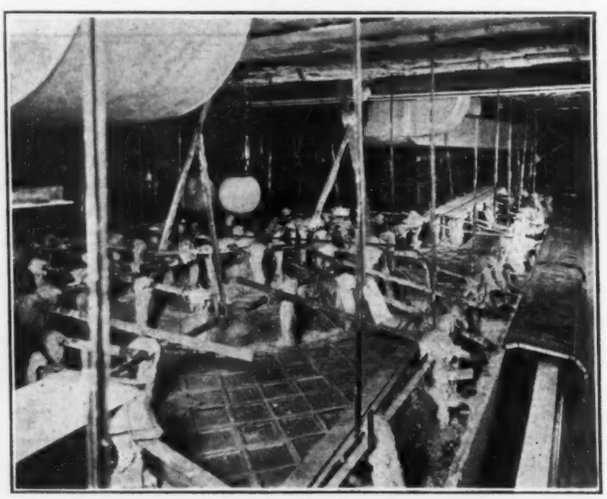


Fig. 7—View Above Auditorium Ceiling, Showing Box Reflector, Flame-Arc Lamps and Nitrogen-Vapor Tube Lamps.

LIGHTING OF THE BANQUET HALL.

The lighting of the banquet hall was a comparatively simple matter compared to the lighting of the auditorium. As above explained, there are forty-nine glass sashes in the banquet hall

ceiling, each sash forming the top of a ceiling coffer. The area of each sash is 25 sq. ft., from which 10 per cent should be deducted for sash bars and mullions, leaving 22.5 sq. ft. net glass area per sash—a total glass area of 1100 sq. ft. Above each sash is a box reflector similar to those used over the sashes in the auditorium ceiling. Each reflector contained eight 40-watt clear-bulb 112-volt tungsten lamps. In Fig. 8 is shown a view of the space above the ceiling of the banquet hall, where the box-type reflectors are used.

Discussion.

Mr. A. J. Marshall called attention to the great value of the results recorded in giving an impetus to scientific illuminating

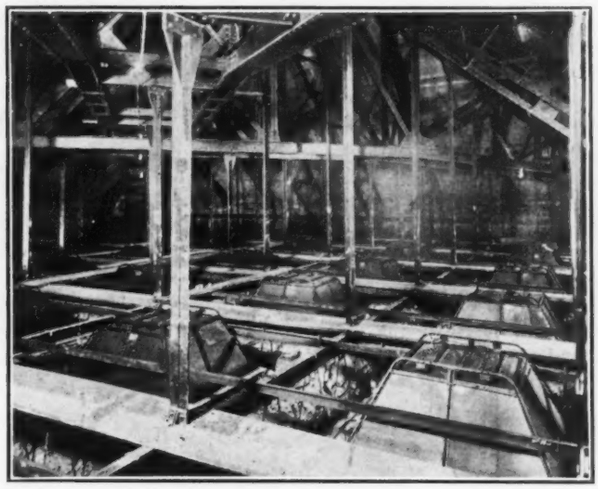


Fig. 8—View Above Banquet-Hall Ceiling, Showing Box-Type Reflectors.

engineering. These results have been rendered possible by reason of the co-operation between the illuminating engineer and the architect. Such co-operation is highly desirable from every point of view.

Mr. Henry Hornbostel, of the firm of architects responsible for the design of the building described in the paper, remarked that efficiency as measured by the ratio of light utilized to light produced is of small importance when compared with beauty of results in a structure such as the Soldiers' Memorial. In arranging the illumination of any room attention must be given to the uses to which the room will be put. In the home cheerfulness should be the keynote; in a dance hall brilliancy is the prime requisite. In many installations a greater attention to color effects than has been given in the past would result in better satisfaction. The greatest obstacle to progress at the present time is tradition inherited from the past. The time has arrived for overthrowing certain traditions relating to illumination requirements and for establishing new ideals, especially concerning color combinations.

Mr. G. H. Stickney stated that the striking illuminating effects in the auditorium of the Soldiers' Memorial produced a feeling of reverence rather than one of gayety.

Dr. A. H. Elliott remarked that the installation described is of the greatest importance in forming a monument to the beginning of a new era in lighting.

Mr. J. B. Taylor cited an observation of a certain lighting equipment in a home where the tungsten lamps in the living-room had been dipped to render the light yellow, and expressed the opinion that under such circumstances the tungsten lamp would prove no more efficient than the carbon lamp, which would deliver light of the desired cheerful color without dipping.

The paper was also discussed from the viewpoint of the architect by Messrs. Jacobi, Comstock and Effinger, all of whom expressed admiration for the methods employed and results obtained.

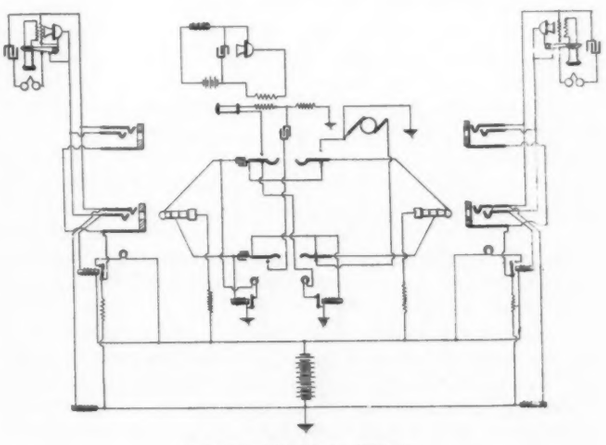
RECENT TELEPHONE PATENTS.

SWITCHBOARD-CIRCUIT SYSTEMS.

With party-line ringing, especially with the four-party selective system, it has been customary to furnish each cord-pair with an individual ringing key for each different type of ringing current. As in ringing it is always necessary to use a cut-off type key, such a series of ringing keys would introduce numerous contacts in the talking circuit unless some special arrangements to avoid this were made. In the past it has been customary to use a gang key, wherein the operation of each plunger not only caused the application of its corresponding type of ringing current to the line, but also operated a cut-off key common to all the individual ringing keys. Such an arrangement, of course, requires a mechanical contrivance to connect all ringing keys with the single cut-off key. In order to overcome the necessity for such a mechanical device Mr. A. H. Weiss, of Chicago, has substituted a cut-off relay for the usual cut-off key. The depression of any of the selective ringing keys causes the operation of the cut-off relay incidentally. Mr. Weiss has obtained a patent for this arrangement, which has been assigned to the Kellogg Switchboard & Supply Company.

A patent granted to Mr. A. H. Dyson, of Chicago, and assigned by him to the Stromberg-Carlson Telephone Manufacturing Company, describes a common-battery, multiple-switchboard system. In this system the jacks are of the three-wire type, the circuits of the supervisory lamps being carried over one of the talking strands on both calling and answering cords. It will be seen that such a use of the talking strand might interfere with the busy test and also with ringing. To overcome this difficulty there have been introduced special features in the ringing and listening keys. The listening key is arranged on the calling-cord side and when operated serves not only to connect the operator to the cord strands, but also to sever the lamp connection with its ground connection. Furthermore, the ringing key is arranged so that its cut-off springs sever both the lamp and supervisory relay connections from the talking strands so that the ringing current will not be shunted. This circuit is shown in the accompanying illustration.

A novel arrangement is also used for the control of the line



Dyson Telephone System.

lamp. It will be noticed that the line relay remains energized throughout the connection, but that the shunt associated with the sleeve of the plug serves through disconnection with the jack sleeve to shunt out the line lamp by connecting the battery around it.

Mr. C. S. Winston, of Chicago, has patented a trunking system, the special feature of which lies in a method of through ringing from the outgoing end of the trunk to the called subscriber. The application of the ringing key in the outgoing operator's connecting cords serves to ground one side of the trunk line, and this in turn causes the operation of a ring-

ing relay with contacts included in the talking strands of the distant end of the trunk. The trunk is designed for use with the two-wire system where a cut-on relay must be continuously energized to maintain a connection between the jack terminals and the subscriber's line. The ringing relay is arranged so that during its operation a shunt circuit is closed to provide a non-inductive return for the ringing circuit. The details of the circuit are arranged to meet the special requirements of the switchboard system for which the trunk is designed, the usual disconnecting lamp being provided to indicate to the trunk operator when the distant A operator has cleared the outgoing end.

Letters to the Editor.

Hydroelectric Head of 585 Feet.

To the Editor of Electrical World:

Sir:—In the report in your issue of Nov. 17 (page 1163) of Mr. James Lyman's lecture before the Chicago Electric Club on "Recent Hydroelectric Developments in the West" the statement is made that the 10,000-kw turbines of the Great Western Power Company are operating under the highest head (430 ft.) under which turbine wheels have ever run. Permit me to call attention to the fact that the Pacific Gas & Electric Company has had in operation for several years a turbine operating at practically 585-ft. head, or 36 per cent greater than the Great Western units. This is a single-discharge turbine of 9000 hp and compares well in efficiency with the Great Western units and has given excellent results.

San Francisco, Cal. F. G. Baum.

Power-Factor and Synchronous Condensers.

To the Editor of Electrical World:

Sir:—In the Nov. 10, 1910, issue of the *Electrical World*, page 1126, in an article by Mr. L. S. Thurston appears a misleading statement concerning the effect of low power-factor on the regulation of an alternator, as follows: "But when the power-factor is lower this ratio does not hold, because the lagging current at low power-factors opposes the mechanical strength of fields, thus reducing the voltage at the generator terminals."

It is evident that the writer is emphasizing the fact that a well-designed alternator will maintain the normal voltage without excessive temperature rise with its normal kva rating at a power-factor as low as 80 per cent, although the design may not include a field strength so strong in comparison with the armature demagnetizing effect that voltage can be maintained at still lower power-factors.

However, the statement quoted above is unfortunate, as it is only necessary to recall that the wattless component of the load, and, therefore, the demagnetizing component, while zero at 100 per cent power-factor, is 14 per cent at 99 per cent power-factor, 20 per cent at 98 per cent power-factor, 43 per cent at 90 per cent power-factor, and 60 per cent at 80 per cent power-factor. Therefore, a curve plotted between field current as ordinates and power-factor as abscissas will be very much steeper at high power-factors than at lower within the range of the ability of the machine to maintain the voltage at a safe temperature rise.

Wilkinsburg, Pa. V. W. Shear.

To the Editor of Electrical World:

Sir:—Although it has the same limitations as have the chart and table given by Mr. L. S. Thurston in his article of your issue of Nov. 10, I believe that engineers will find the following formula useful in calculations involving the rating of synchronous condensers for power-factor correction:

When kva = rated load for kilovolt-amperes of the system the power-factor of which is to be improved,

$\cos \Theta_1$ = present power-factor,

and

$\cos \Theta_2$ = desired power-factor,

then

the rating in kilovolt-amperes of a synchronous condenser necessary to raise the power-factor from $\cos \Theta_1$ to $\cos \Theta_2$

$$= \sqrt{(\text{kva})^2 - (\text{kva}\cos\Theta_1)^2} - \sqrt{(\text{kva})^2 - (\text{kva}\cos\Theta_2)^2}$$

The following, while not so convenient to handle, is incidental to the derivation of the above:

$$\text{Rating of condenser} = \text{kva}\sin\Theta_1 - \text{kva}\sin\Theta_2$$

when Θ_1 and Θ_2 are angles whose cosines are as given above.

In the above it is assumed that there is no mechanical load on the condenser. The most economical load which can be imposed on this machine is one whose value in kilowatts is equal numerically to the lagging wattless kilovolt-amperes in the circuit. If this load can be obtained the rating of the condenser should be equal to the value obtained in the above formulas divided by 0.707.

While the calculations upon which the above are based are entirely theoretical, the results obtained by their use will be found very satisfactory in practice.

Morrisburg, Ontario. A. J. Pownsend.

Wattless Power.

To the Editor of Electrical World:

Sir:—I have read with interest the communication of Mr. C. O. Mailloux appearing in the issue of Nov. 24 on the subject of a suitable name for wattless phenomena.

It seems to the writer there is too much mystery shrouded about what is really a very simple matter. It is certainly unfortunate that there are so many different energy names for something which involves no energy. It would be, to say the least, somewhat absurd to point out that the operating voltage of the Niagara Falls Power Company multiplied by the current of the Brooklyn Rapid Transit System represented an amount of power which was fictive, although its factorial components had real values. It would be still more absurd to get into a mighty stew as to what this fictive power should be called, or to argue any power relation because the components happen to be in the same state.

The writer does not question the mathematical convenience of multiplying two non-simultaneous effective values together and bearing in mind the nature of the result, but such a procedure is the bane of the practical student. It would seem that our troubles could be made more truly wattless by ceasing to write a faulty power equation of volts times amperes without qualification, which is by no means universally true even in direct-current work.

A few years ago a device known as the "rheocrat" was constructed for direct-current control. This machine rapidly made and broke a circuit, and supplied direct current to the consuming device in periodic doses, which resulted in reducing and controlling the power in the consuming circuit. An ammeter placed in a circuit so controlled and a voltmeter shunted around the terminals of the rheocrat gave readings which multiplied together produced an amount of "power"! Many were inclined to charge this power to the unfortunate rheocrat, entirely losing sight of the fact that similar readings on the consumer circuit, similarly combined, produced another amount of "power" which added to the first gave a total exceeding the power similarly measured from the mains. This phenomenon produced altogether too great a splash in our

placid theoretical pond in the absence of a properly written power equation.

Let us, therefore, in a spirit of love and accuracy incorporate into our power equation the saving qualification "simultaneous." Let us never cease to point out that the volt-ampere is a watt only under certain conditions. Let us call the excess currents and voltages which appear on our circuits reactions and forever divorce from their names the words "power" and "watt." We are then at liberty to point out without incongruity the power that these reactions consume, whether it be excess I^2R, dielectric or magnetic hysteresis or eddy currents, according to the nature of the circuits in which they are found.

To the practical user of alternating currents, graduate as he always is of a primary direct-current school, this will appeal. The mind cannot be readily divorced, and it is not desirable that it should be, from the actual power output of the system; and it would seem much easier to conceive of the excess currents and voltages due to reactance as reactions superposed upon the power circuit, capable of being estimated and necessitating a reinforcement of structure to sustain them. Why they should be referred to as power of any kind in order to fit a power equation improperly written in the days when the Ferranti effect was a mystery is inconceivable. The phenomena are due to reactance, a most admirably chosen word, and their logical name is current or voltage reactions, according to whether the circuit is parallel or series.

Finally, let us cease to say that Ohm's law is not universally true and further forbear to discredit the fundamental tenet of our profession to accommodate a misleading nomenclature. E always equals IR, although E may not be the terminal voltage of a circuit, and the writer is not aware of any record that the great pioneer ever so designated it.

New York. GEORGE T. HANCHETT.

Voltage-Wave Distortion and the Life of Incandescent Lamps.

To the Editor of Electrical World:

SIR:—The editorial in the issue of Nov. 17 relating to the investigation of the effects of alternating-current wave-form on the life and efficiency of incandescent lamps, a report of which was published in a recent issue of the *Bulletin* of the Engineering Experiment Station of the Pennsylvania State College, and the later communication to your paper from Dr. Clayton H. Sharp, seem to make necessary a statement of certain additional information concerning these tests. At the same time, please permit me to take exception to two statements contained in your editorial as well as to a number of Dr. Sharp's criticisms.

Referring first to the editorial, I would call attention to your statement in the first paragraph, which reads, " * * * it is usually believed that the candle-power, specific consumption and life of incandescent lamps vary with the 'mean effective' value of the e.m.f. quite independently of the maximum value." It is not my purpose to contradict this statement at this time, but merely to say that it has thus far been found impossible to obtain definite and authoritative information on that point which would either substantiate your conclusion or prove it to be incorrect. However, an examination of the large number of letters from manufacturers of incandescent lamps and from well-known engineers which have been received since the publication of the results of the investigation shows a decided difference of opinion to exist concerning this point. Efforts to secure results of tests whch led to the formation of these several opinions have been unavailing, and until such proof is forthcoming some reasonable doubt may be assumed to exist. At the present time the Experiment Station of the Pennsylvania State College is preparing to make a series of tests which, it is hoped, will aid in the determination of this question.

In Dr. Sharp's communication he reports tests made at the Electrical Testing Laboratories, in New York, which showed the life of incandescent lamps to be shorter on direct current than on alternating current of either 25 cycles or 60 cycles, but he adds that his tests are not considered conclusive. But where may conclusive evidence be obtained?

Further, the editorial states that in the case of an alternating e.m.f. the range of the cyclic fluctuation of temperature depends upon the wave shape and upon the heat-storage capacity of the filament. Here, again, definite information is lacking, but it would seem that the range of the cyclic fluctuation of temperature would also depend upon the frequency of the alternating e.m.f., the *range* being greater with the lower frequency and less with the higher frequency.

If the injurious effect of the peaked wave is due to a higher maximum value that that of a sine wave of equal effective value, then unquestionably a similar result should be obtained by comparing the life of lamps on a unidirectional e.m.f. with the life on a sine wave, but if any part of the injury to the filament is due to the *range* of the cyclic fluctuation of temperature, then a lower frequency might be expected to be more injurious than a higher frequency.

Referring now to Dr. Sharp's letter, the following replies may be made to his questions, taking them in the order in which they are asked:

In making the tests described in the *Bulletin* a total of eighty lamps were used, forty being tested on each wave. It is undeniably true that there is great likelihood of being led to wrong conclusions by basing one's views on the performance of an insufficient number of lamps, but certainly added strength is given to the evidence in the case at hand by the fact that *every lamp in each group* showed results similar to and consistent with the *average results* published in the *Bulletin*. There was not a single exception to this statement.

It was clearly stated in the *Bulletin* that no effort was made to obtain voltage regulation which should be better than that of a well-regulated lighting circuit, and it necessarily follows that close current regulation was not attempted; but it must be borne in mind that the two waves were obtained from the same alternator and the tests were conducted simultaneously, so that any fluctuation in one wave was accompanied by a similar variation in the other.

The lamps were burned on life test at their normal rated voltage of 110 volts, and not at a fixed value of watts per candle.

The photometric measurements were made on alternating current and on the same wave-form as that on which the life test was being run. During these measurements the rated effective volts were applied to the lamps. In fact, the lamps were at no time burned under other than the above-described conditions.

Watts supplied to the lamps were measured on alternating current by an indicating ammeter of the dynamometer type and by a Weston voltmeter.

The frequency of each wave was 60 cycles.

The "smashing point" in all cases refers to the ultimate life of the lamps, the point where the filaments were broken. All lamps were burned to the smasing point thus defined. The *Bulletin* notes the fact that no lamps were broken in handling. Consequently the differentiation of the lamps into classes was unnecessary.

The following is quoted from Dr. Sharp's letter: "Certainly lamps can be burned at the same watts per candle on peaked wave that they can on sine wave. That is only a question of voltage. Certainly lamps can be made to give as much candle-power on peaked wave as on sine wave. That is also a matter of voltage." Undoubtedly lamps can be burned at the same watts per candle on a peaked or on a sine wave and it is a question of voltage, but is there conclusive evidence to show that two lamps which are exactly alike, or even the same lamp, will consume exactly the same amount of energy *when burned at the same effective voltage* on both wave-forms? Undoubtedly lamps may be made to give exactly the same candle-power on peaked or on sine wave and that also is a matter of voltage;

but can Dr. Sharp state positively that two lamps which are exactly alike, or even the same lamp, will give exactly the same candle-power *when burned at the same effective voltage* on the two wave-forms? The writer believes that he can not.

Unless both of the foregoing questions can be answered positively in the affirmative, Dr. Sharp's "natural inference" is without sound premises.

In reply to the question as to the division of lamps into two groups, it may be said that they were selected at random from a lot of about 100 lamps obtained from two manufacturers. The lamps from each company were received in one shipment and presumably were manufactured at about the same time. Each group contained an equal number of the same make of lamps.

Dr. Sharp asks, in case the lamps were selected at random (in which case he admits the results to be comparable), " * * * how is the fact that the candle-power of the lamps in one group was persistently high and their watts per candle persistently low to be explained?" The writer at this time does not care to submit a possible theoretical explanation. It is, however, inconsistent to challenge the correctness of experimental evidence which for the time is unsupported by theoretical proof when there is neither experimental nor theoretical evidence which is beyond question to disprove it.

Dr. Sharp gives as collateral evidence tests performed at the Electrical Testing Laboratories to determine the life of lamps on direct current and alternating currents of 25 cycles and of 60 cycles. These tests showed the longest life to have been obtained on alternating current of 25 cycles, the shortest life to be on direct current and the life on alternating current of 60 cycles to be about midway between the other two. These results are perhaps no less surprising than those contained in the *Bulletin*. Dr. Sharp frankly admits these results to be "inconclusive" for two valid reasons, and naturally the writer is unwilling to accept them as satisfactory evidence to prove the fallacy of his results.

In the second test described by Dr. Sharp the lamps were subjected to pressure waves differing in two respects. One wave was markedly peaked and had a frequency of 133 cycles; the other was but slightly peaked, the third harmonic (which is assumed to have been negative with respect to the fundamental) being but 4.7 per cent of the fundamental, and this wave had a frequency of but 60 cycles. The writer knows of no satisfactory means of separating the effects of the different frequencies from the effects of the different wave-forms, and Dr. Sharp again admits that his tests were inconclusive and yet offers them as "negative evidence" with respect to the tests described in the *Bulletin* because the former "inconclusive" tests made at the Testing Laboratories did not show a marked effect due to frequency.

The inference thus made on the results of two tests, both of which Dr. Sharp admits to be inconclusive to him, under whose direction they were probably performed, can hardly be considered well drawn.

Photographs of magnified filaments reproduced in the *Bulletin* corroborate Dr. Sharp's statement that the filaments of the other lamps do not exhibit the same faulting as do the tantalum filaments when burned on alternating current, but this fact in itself can have but little bearing on the question under discussion.

In the writer's original article mention was made of the fact that plans are under way to perform a series of tests with the third harmonic reversed, as Dr. Sharp suggests near the close of his communication.

Finally, it should be emphasized that the tests published in the *Bulletin* were not and and are not now given as conclusive evidence. The results were obtained from a series of tests performed with extreme care and, it is believed, under proper conditions. It is hoped that later tests will add testimony that will go still further toward establishing facts. The tests so far performed do, however, *indicate* certain conclusions which may eventually be reached; and surely if further evidence be needed firmly to establish these conclusions as facts, it is no less necessary to obtain authentic and contradictory evidence to disprove them.

State College, Pa. Chas. L. Kinsloe.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generation, Transmission and Distribution.

Three-Phase Inclosed Motors with Forced Ventilation.—An illustrated description of new three-phase inclosed motors of the Oerlikon Company. The starting resistor is placed on the same shaft as the rotor, with which it revolves, and inside the casing. The arrangement for operating the starting resistor

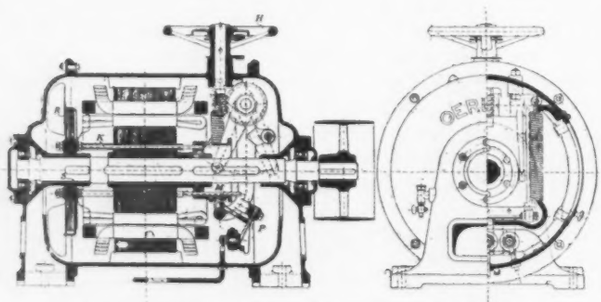


Fig. 1—Inclosed Motor with Forced Ventilation.

also works the main switch, with which it is in keyed connection. A ventilating equipment which is placed inside the motor casing produces a strong current of air, which is drawn into the motor through the foot of one of the end plates and is forced along the whole length of the motor until it is finally expelled through the base of the other end plate. In this way a very efficient ventilation of the motor is obtained in spite of the inclosure and its reduced size. The starting equipment consists of a resistor R (Fig. 1), made up of copper ribbon rolled in the form of a thin coil. This resistor is fixed to the motor shaft directly between the armature on a support S, which also carries the contacts. The contacts are made of polished copper strips of unequal length, which are placed round the shaft and which are successively short-circuited by the sleeve M. The number of contacts is six for motors with ratings not exceeding 25 hp, while the larger sizes have nine. By using this type of starting equipment collecting rings and brushes are not required, thus avoiding the only parts which require constant supervision. Switching in, starting and short-circuiting the winding are all effected by the hand wheel H, which is placed on the motor body. By turning this wheel to position I the switch P is operated, strong springs insuring a good contact. Further turning of the wheel in the same direction operates the sleeve M, thus gradually short-circuiting the starting resistor. To switch out the motor the wheel is turned in the opposite direction.—Lond. *Electrician*, Nov. 25.

Variable-Speed Motor.—P. Bary.—A translation of his recent French paper on the B. V. D. variable-speed motor and its application to traction work. As noticed before in the Digest, the feature of the motor is the fact that the fluxes of the main field poles and of the commutation poles are partly overlapping.—Lond. *Electrician*, Nov. 25.

Polyphase Series Motor.—R. Rüdenberg.—The first part of

a mathematical paper in which the author develops diagrammatically the principal properties of the three-phase series motor. To simplify matters several approximations are made. A simple circular diagram is given to explain the phase compensation and the variation of speed. The paper is to be concluded.—*Elek. Zeit.*, Nov. 24.

Induction Motor.—J. REZELMAN.—A continuation of his long mathematical investigation of "synchronous and non-synchronous reactance." In the present instalment the author considers the case of a 50-hp, three-phase induction motor with squirrel-cage secondary.—*La Lumière Elec.*, Nov. 12.

Lamps and Lighting.

Street Lighting.—H. T. HARRISON.—The author first gives details of the street lighting of the borough of St. Marylebone, where incandescent gas lamps have recently been replaced by metallic-filament lamps. The cost of the conversion and of maintaining the electric lamps is set out. He also points out that, with the exception of very important streets, the tungsten lamp will give a better result at lower cost than the open-type arc lamp. But it would be unwise to incur fresh capital charges by replacing existing arc lamps with a large number of small posts and fittings. In Croydon the experiment has been made to use groups of tungsten lamps contained in one lantern fixed as high as possible from the ground. It was found that a group of three 110-watt osram lamps, contained in a suitably designed and constructed lantern, erected from 20 ft. to 30 ft. above the ground, gave a much better minimum illumination

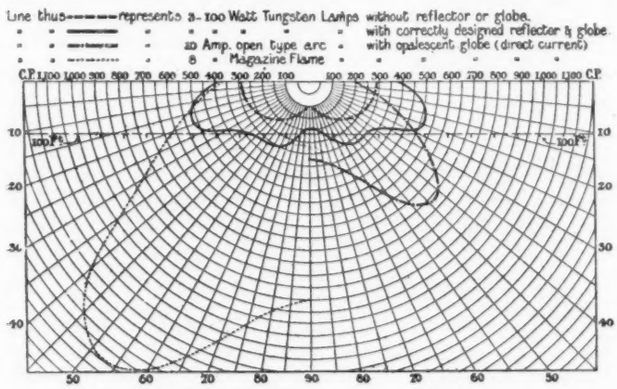

Line thus——— represents a 100 Watt Tungsten Lamps without reflector or globe.
with correctly designed reflector & globe.
10 Amp. open type arc
with opalescent globe (direct current)
8 " Magazine Flame
C.P. 1100 1000 900 800 700 600 500 400 300 200 100 100 200 300 400 500 600 700 800 900 1000 1100 C.P.
10
20
30
40
50 60 70 80 90 80 70 60 50

Fig. 2—Light Distribution Diagram.

and much more even illumination than the arc lamps. These lanterns are designed to have a larger area of white reflecting surface in very close proximity to the incandescent metal of the lamp, with the object of making the source of light appear large so as not to strain the eye in any way. And owing to the height at which these lamps are erected this white surface can be and is designed to act as an efficient reflector and does considerably improve the distribution of light by nearly doubling the candle-power at 30 deg. from the horizontal, as will be seen from Fig. 2. The horizontal dotted line shows the position of the pavement to light angles for the lamp 20 ft. high. This compares the distribution from tungsten lamps fitted in these lanterns with that of an open-type arc lamp. The illuminating results are as follows, these lamps being 73 yd. apart and from 20 ft. to 23 ft. high: The minimum direct illumination is 0.041 ft.-candle when using the tungsten group lantern, against 0.024 ft.-candle with the 10-amp open-type arc lamp. The cost per mile is approximately $1,000 per year; thus a minimum illumination double that of arc lamps is obtained and at slightly over half the cost. When these roads were lighted by gas mantles the minimum direct illumination was 0.0036 ft.-candle, so that the illumination is now about ten times as high, the cost being about three times as great. The paper is to be concluded.—Lond. *Electrician*, Nov. 25.

Street-Lighting Costs.—C. TOONE.—The first part of a paper illustrated by diagrams in which the author gives details of the annual cost of running and upkeep of various electric street lamps in 150 British cities, including carbon, metallic and Nernst-filament "incandescent" lamps, and open, inclosed and flame-arc lamps for direct and alternating current. In the present instalment the author deals with actual annual costs, voltage and current of various arc lamps; grouping of various pressures; burning hours per year. Tables and diagrams are given. The paper is to be continued.—Lond. *Elec. Review*, Nov. 25.

Sterilization of Water by Ultra-Violet Rays.—M. B. DAGUERRE.—A note stating that at first sight it would seem that the ultra-violet rays would be absorbed to so great an extent by liquids that bacilli could not be reached at any depth. A millimeter thickness of water absorbs completely waves below 1800. The author, however, has discovered that the ultra-violet rays exert remarkable sterilizing effect on water. It seems possible that it may be a surface effect which is transmitted from bacilli to bacilli, for the light certainly has little penetrating power. The sterilizing action appears to be confined to clear water; impurities, suspended particles and colloids arrest it. Daguerre places a mercury-vapor lamp in a tube through which the water circulates.—*Amer. Journal of Science*, December.

Effects of Ultra-Violet Rays.—E. SCHNECKENBERG.—The author first discusses the sterilization of water by means of ultra-violet rays obtained from quartz tubes filled with hydrogen gas through which electric discharges are passed as in the case of Geissler tubes. He then discusses the penetration of ultra-violet rays through various liquids and the decomposition of carbonic acid gas and steam and the formation of hydrocarbons by ultra-violet rays. He finally deals with the decomposition of chemical compounds of carbon by ultra-violet rays.—*Elek. u. Masch.* (Vienna), Nov. 20.

Generators, Motors and Transformers.

Low-Pressure Steam Turbines.—F. E. MCKEE.—A paper on the possibilities of the exhaust steam turbine. The author gives results of various installations and points out that the application of low-pressure turbines is flexible and can be used in connection with almost any existing engine plant with remarkable results. The size and design of engines, nature of engine load, as well as general operating conditions, all influence the selection of the turbine and every case must be thoroughly considered in all its details. There was an extended discussion.—*Proc. Eng. Soc. of Western Penna.*, November.

Charging Zinc Furnaces.—C. HOEBENER.—An illustrated description of a machine of Saeger for charging mechanically the retorts of zinc furnaces. This may best be done by the use of electric motors. Special appliances had to be devised, due to the high temperature to which the apparatus is subjected.—*Elek. Zeit.*, Nov. 24.

Installations, Systems and Appliances.

Starting of Induction Motors.—F. BROADBENT.—An article on methods of protecting an induction motor against overloads and at the same time permitting the motor to take a heavy current, when starting, without blowing the fuse or opening the circuit-breaker. A change-over switch which permits of the use of a heavy fuse during starting and a lighter fuse when the motor has run up to speed is probably the most commonly adopted, but unless the switch is automatic and flies over to the running position on being released there is always the risk that the switch will be left in the starting position when only the heavy fuse is in the circuit. When rheostatic starting switches are used there is a simple method of getting over the difficulty. From the point of view of the machinery insurance company it is the motor which needs protection rather than the cables leading to it. Any leakage or defect in the cable work rapidly develops into a short-circuit, and, therefore, the cables may be more heavily fused than the motor, which needs to be protected against, say, a 50 per cent or 100 per cent overload. The simple method referred to is to place the circuit-breaker or fuse between the last two contacts of the rheostatic starter, taking the motor connection from the contact next to

the last, this being the last resistance contact (Fig. 3). This fuse, or circuit-breaker, is not in circuit at all during starting, but comes into action only when the starter handle is pushed over to the last stop, the starting resistor having in the mean-

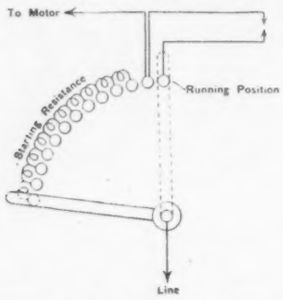


Fig. 3—Diagram of Motor-Starting Device.

time been all cut out and the motor run up to full speed.—Lond. *Elec. Eng'ing,* Nov. 24.

British Central Station.—An abstract of last year's financial account of the West Ham municipal central station. The total number of kw-hours sold was 19,156,399, of which 11,694,432 kw-hours, or 43 per cent, make up the motor load, 4,815,592 kw-hours the tramway load, and the balance the lighting load, which is of minor importance. For private lighting 1,948,797 kw-hours were sold. In the whole 23,827,281 kw-hours were generated. The generating cost per kw-hour sold was 0.70 cent; the distribution cost, 0.10 cent; the cost attending lamps, 0.08 cent; the management cost, 0.20 cent; the total cost, including rents, taxes, etc., 1.22 cents, and including capital charges, 2.06 cents.—Lond. *Electrician,* Nov. 25.

Controlling Voltage at Feeder Points.—C. Laue.—An illustrated article describing a new and simple method of controlling the e.m.f. at the feeding points of direct-current networks. Milliammeters inserted in the testing wires permit one to find directly the voltage differences between the different feeding points.—*Elek. Zeit.,* Nov. 24.

Wires, Wiring and Conduits.

Aluminum versus Copper Cables.—F. C. Raphael and J. B. Sparks.—The conductivity of aluminum is three-fifths that of copper, so that an aluminum conductor of 0.5 sq. in. cross-section will take the place of 0.3 sq. in. copper conductor. The corresponding aluminum conductor is, however, much lighter, and, as the cost of aluminum per pound is not very much greater than that of copper, the aluminum cable in its uninsulated state is far cheaper. The larger amount of insulation and lead necessary to cover the larger diameter to the same radial thickness diminishes the advantage, but the fact remains that for cable above a certain size aluminum is cheaper, at least for single-core, low-tension cables. With respect to paper-insulated, lead-covered cables, the authors recommend cable users to obtain alternative prices when buying cable of 0.1 sq. in. upward. For ordinary vulcanized bitumen cables for laying on the solid system aluminum is considerably cheaper in all sizes; in fact, the difference is so great that aluminum will also be cheaper for armored cables. For shaft cables in mines aluminum will be cheaper also, but it must be pointed out that, in case of armored cables, it will not be lighter, as the extra weight of armoring on the larger-diameter cable more than compensated for the lighter conductor. The authors then discuss joints and describe experiments in which they found that for ordinary service connections mechanical aluminum clamps similar to the brass clamps used in standard joint boxes can be employed for aluminum cables without any risk of connection not being made with the inner strands. It is important that the clamps should be screwed up rather more firmly than usual so as to break down mechanically the insulating film on the outer strands and to squeeze out the oil or other foreign matter which may have run between the individual strands and layers. Methods of joints used in different British cities are then described.—Lond. *Elec. Eng'ing,* Nov. 24.

Temperature-Resistance Coefficient of Copper.—J. H. Dillinger.—A preliminary report to the American Physical Society on the temperature coefficient of the resistivity of copper. The values in use for this constant vary widely and are based upon but little experimental work. None of these values, therefore, can be relied upon to give accurate results when applied to any particular sample. The present investigation indicates a simple linear relation between the conductivity and the temperature coefficient, so that a measurement of the former gives also the latter for any particular sample. The relation is found to hold for samples of both lake and electrolytic copper, and for both annealed and hard-drawn samples throughout the range of conductivity of copper now on the market. The relation is in corroboration of a conclusion of Matthiessen's for the pure metals. It may be expressed as follows: The 20 deg. C. temperature-resistance coefficient of a sample of copper is given by multiplying 0.00393 by the percentage conductivity. (Percentage conductivity is reckoned on the basis of 100 per cent conductivity corresponding to 0.1530_{28} ohm per meter-gram, or 1.721_{28} micro-ohms per centimeter cube at 20 deg. C.). There may be herein an explanation of the disagreements of previous determinations of the temperature-resistance coefficient. The temperature coefficient assumed by the American Institute of Electrical Engineers, 0.0042 at 0 deg. C., or 0.00387 at 20 deg. C., corresponds to a conductivity of 98.6 per cent; if it were used for a sample whose conductivity is 100.3 per cent (an average value for the annealed copper of commerce) the error of the computed value at 100 deg. C. would be over one-half of 1 per cent.—*Phys. Review,* November.

Excessive Voltages.—A. Leaute.—Large feeders are generally provided with two circuit-breakers, one in the plant and the other in the distributing network. In putting the line under current by closing the circuit-breaker in the station excessive voltages can be produced. This fact had been investigated by Wagner. The present author takes up the other problem of determining the excessive voltages produced when the circuit-breaker in the network is closed. The fundamental formulas of the problems are given. The paper is to be continued.—*La Lumière Elec.,* Nov. 19.

Fuses.—E. Jasse.—The first part of an article on the theory of fuses. In the present instalment the author derives the fundamental equations of the heating of a fuse and then discusses applications of his equation with the aid of diagrams.—*Elek. u. Masch.* (Vienna), Nov. 20.

Electrophysics and Magnetism.

Congress of Radiology.—R. B. Boltwood.—An account of the proceedings of the International Congress of Radiology and Electricity held in Brussels in September. The proceedings were begun by Professor Rutherford, who stated that he had recently compared by the gamma-ray method the radium standards employed in the leading laboratories of several different countries and had observed very considerable differences, amounting in some cases to 20 per cent, between them. He pointed out the importance of a uniform international standard by which the results and experiments of workers in all parts of the world might be brought into accord. It was, therefore, suggested that a specimen of the purest obtainable salt of radium should be prepared and accepted as an international standard and that facilities be afforded by which all scientific workers might be able to express their results in terms of that standard. An address was given by Mme. Curie on the subject of her recent experiments on the preparation of metallic radium. In the discussion of the subject of nomenclature it was suggested that the term "half-value period" should be used to express the time required for any given radioactive product to become half transformed into other substances, and that the expression "active deposit" should be used in place of the terms "induced" and "excited" activity. These proposals were received with general approval. A large number of papers

were presented in the following days before different sections of the congress. At one of the last meetings the International Committee of Standards reported, and among its recommendations which were formally adopted are the following: Mme. Curie has agreed for the purposes of the standard to prepare a quantity of the purest obtainable anhydrous radium chloride containing about 20 milligrams of radium (element). This will be used only for the measurement and comparisons of secondary standards by means of the gamma rays. The original standard is to be suitably preserved and deposited in Paris. Through the committee national scientific laboratories and bureaus of standards willing to pay the costs are to be provided with certified secondary standards. As radium emanation is now so generally used in scientific investigations, the committee considers the adoption of a unit for the measurement of the amounts of radium emanation desirable. The committee recommends that the name "Curie" be given to the quantity of mass of emanation in equilibrium with 1 gram of radium (element). The millicurie would thus be the amount of emanation in equilibrium with 1 milligram of radium. The cost of the primary standard will be about $2,500.—*Science,* Dec. 2.

Carriers of Positive Electricity.—F. HORTON.—A note on a paper read before the Royal Society in London. The emission of positive ions from substances heated in a vacuum has been investigated by several experimenters and it has been found that the ratio of the charge to the mass of the ions is the same for all substances so far experimented on. Assuming that the charge is equal to that carried by the hydrogen ion in electrolysis, the mass of the carriers of positive electricity from heated substances must be about twenty-six times that of the hydrogen atom. The object of the present research was to obtain the spectrum of these ions. Aluminum phosphate was chosen for investigation because of the very large positive ionization produced on heating this substance. A calculation showed that, with the apparatus used, one might expect to collect a sufficient quantity of the carriers to obtain their spectrum in a small vacuum tube. The vessel used to collect the carriers was cooled in liquid air during the passage of the thermionic current from a strip of platinum covered with aluminum phosphate to a surrounding platinum cylinder. The material collected was then allowed to vaporize and its spectrum was obtained by rendering it luminous with an electrodeless ring discharge. The spectrum of carbon monoxide was always obtained, although precautions had been taken to exclude this gas or materials which might give rise to it from the apparatus. It was concluded, therefore, that the positive ions consisted of carbon monoxide, the molecular weight of which agreed fairly well with that required by the results of the *e/m* determinations. It was considered improbable that this gas was evolved on heating every substance which had been experimented on in the determinations of the specific charge, but from the nature of the apparatus used it must always have been present during these determinations. In the paper reasons were given for believing that molecules of carbon monoxide readily acted as carriers of positive electricity and this gas probably diffused into the hot metal or other substance and was evolved in an ionized state.—Lond. *Electrician,* Nov. 25.

Selenium.—L. S. MCDOWELL.—A third paper on the author's experimental researches on electric properties of selenium. The chief results are summed up as follows: The actions of light and of heat in producing change in the conductivity of selenium are apparently identical. The increase in resistance with decrease in temperature continues down to the temperature of liquid air, where the cell becomes almost entirely nonconducting. Changing in conductivity due to excitation by light of the same intensity takes place more slowly at low temperatures than at ordinary temperatures, but the final change produced by saturation is enormously greater. Recovery at low temperatures is markedly slower than at ordinary temperatures.—*Phys. Review,* November.

Crest Factor and Form Factor.—W. C. CLINTON.—The crest factor is the ratio of the maximum amplitude to the square root of the mean square and the form factor is the ratio of the square root of the mean square to the true algebraic mean over half a period. The author gives general expressions for the crest factor and form factor of periodic functions in terms of the harmonics. Expressions for maximum crest factor and minimum form factor are given, and curves for certain special cases are reproduced.—Lond. *Electrician,* Nov. 25.

Electrochemistry and Batteries.

Calcium Cyanamide.—M.DEKAY THOMPSON AND R. H. LOMBARD.—An experimental investigation of the equilibrium of the system consisting of calcium carbide, calcium cyanamide, carbon and nitrogen. The equilibrium pressure of nitrogen in the reaction $CaC_2 + N_2 = CaCN_2 + C$ was determined from both sides for a number of temperatures between 1050 deg. C. and 1450 deg. C. The free energy increase of the reaction taken from left to right is — 1714 gram-calories at 1450 deg. C. and — 6700 calories at 1100 deg. C. Calcium cyanamide distils to the cold parts of the furnace at temperatures as low as 1050 deg. C. Pure lime distils appreciably in the neighborhood of 1500 deg. C.—*Met. and Chem. Eng'ing,* November and December.

Units, Measurements and Instruments.

Alloys for Permanent Magnets.—C. F. BURGESS AND J. ASTON.—An account of an extended investigation of various alloys made from carbon-free electrolytic iron, with respect to their suitability for permanent magnets. The desired feature is as high a residual magnetism as possible, or, better, a high retentivity after some disturbing factor has tended to destroy the residual magnetism, together with a high coercive force to resist the tendency toward this loss of the magnetic flux. The method of measurement was essentially the taking of various readings in a hysteresis loop test. All alloys which showed a fair retentivity and a fairly high coercive force were then subjected to a test for their stability or their ability to hold residual magnetism after shock. The results are given in various tables. In a general way it appears that chromium, manganese, molybdenum and tungsten are the important additions in the manufacture of steels for permanent magnets, but the presence of some third element is necessary. While carbon is beneficial, it is possible to obtain highly satisfactory materials either by various combinations of the above four elements or by suitable additions of silicon or vanadium, the latter, in particular, being very desirable. Moreover, suitable materials may be made which will require quenching, although in this case carbon is beneficial; if desired, equally satisfactory results may be obtained without carbon.—*Met. and Chem. Eng'ing,* December.

Frequency Meters.—O. MARTINENSSEN.—An article in which the author first described Ferrie's frequency meter, which is based on the formula

$$2\pi f = \frac{1}{L}\sqrt{\frac{E^2}{I^2} - R^2},$$

which is valid for a circuit containing resistance and inductance, where f is the number of alternations per second, L is the coefficient of self-induction, R the resistance, E the voltage and I the current. If L and R are constant f is a function of E and I. The frequency meter of Ferrie is, therefore,

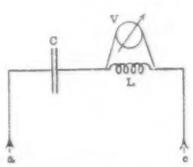


Fig. 4—Diagram of Frequency Meter.

a combination of a voltmeter and an ammeter placed side by side so that the needles of the two instruments intersect each other. The point of intersection determines the frequency. This instrument has already been described in the Digest. The wave-form has, however, an effect on the measurement since

the fundamental equation holds good only for a sine wave. The author has devised a measurement which is intended to remedy this defect. A condenser C is joined in series with a choking coil L, which has a closed laminated iron core, a voltmeter V being connected up as shown in Fig. 4. The values of C and L are so chosen that as the frequency increases over the desired range of the instrument the value of $2\pi fL$ approximates to that of $1/2\pi fC$; the current in the circuit, therefore, increases and consequently also the voltage across the terminals of the choking coil. If the voltage of the circuit changes it can be shown experimentally that, provided the magnetization of the iron in the choking coil is suitably chosen, the voltage at its terminals can be kept constant. The voltmeter V can therefore be calibrated to show the frequency of the current, the results depending in no way on variations of the applied voltage of the circuit. Experimentally it has been found that variations of 10 per cent on either side of the normal produce no effect on the exactness of the readings; neither is it possible to trace anything to variations in the shape of the wave. All the upper harmonics, which have at least three times the frequency of the fundamental vibration, lie far outside the sphere of resonance, and, therefore, produce a correspondingly small effect on the voltage at the terminals of the choking coil. The instrument naturally reads over only a limited range and the voltage must, if necessary, be adjusted by a suitable transforming device. The little choking coil and the transformer can be mounted in the voltmeter case. The condenser consists of a roll of paper which separates two strips of tinfoil, the paper being impregnated under a vacuum with a viscous oil.—Lond. *Electrician,* Nov. 25.

Pyrometry.—C. R. Darling.—A note on a lecture before the Royal Society of Arts in London. After summarizing the work of early investigators, the lecturer dealt briefly with particular methods. The gas thermometer is the foundation of all the accurate work in this direction, and by using platinum-rhodium bulb temperatures up to 1550 deg. C. can be measured by this means. The water pyrometer has the advantage of cheapness, and when made in such a form as that of Siemens it is simple to use, but does not give a continuous record. Seger's cones are made with intervals of 30 deg. C.; the "Sentinel" pyrometers, consisting of a series of salts, give a similar means for determining lower temperatures within certain limits. Expansion pyrometers are apt to give trouble owing to a shifting zero. Graphite in an iron tube has been used with some success in this class of pyrometer and gives the temperature on a dial. Another dial instrument depends upon mercury in a steel tube, this being connected to a pressure gage. The mercury, being under pressure, does not boil, and thus there is obtained a form of mercury thermometer for comparatively high temperatures.—Lond. *Electrician,* Nov. 25.

Resistance Standards.—In the report of the work of the Reichsanstalt during 1909 it is stated that the comparison of the manganin standards continues to give satisfaction; the year was very damp, but the manganin boxes did not show any notable fluctuations. The forty-five standard resistances of the technical laboratory and five standards of the "strong-current" laboratory were re-tested in April and in October in two complete series of measurements (S. Lindeck), some being kept all the time in the hygrostat (air containing 50 per cent of moisture), others exposed to the fluctuations of atmospheric moisture. These tests have now been continued for three years, and in future all the standard resistances will be kept in the hygrostat. Lindeck has also resumed his inquiry into the influence of stress on the resistance of wire. A fine manganin wire covered with two layers of silk was wound on a steel cylinder, 25 mm external diameter, 4 mm wall thickness, 25 cm length, a resistance of 500 ohms covering 6 cm of the middle portion of the cylinder. Hydrostatic pressure was applied internally so as to act radially on the cylinder. The observed increase in resistance amounted to about 0.039 ohm for each pressure increase of 200 kg per square centimeter. These values were concordant, and a permanent increase in the resistance resulted when the pressure was pushed above 800 kg. In another experiment performed with a hardened-steel tube no permanent increase was observed, however, when the pressure exceeded 1000 kg per square centimeter, although the steel was certainly not less sensitive than the other.—Lond. *Eng'ing,* Nov. 25.

Silver Voltmeter and Standard Cells.—In the report of the work of the Reichsanstalt in 1909 it is stated that the work on the silver voltameter and on the mercuro-sulphate Weston cells is proceeding, and that the Weston standard cell should, in accordance with the recommendations of the International Conference on Electric Units in 1908, contain an excess of cadmium sulphate crystals and not merely be saturated with cadmium sulphate at 4 deg. C. New cells of the latter type were submitted in 1909 to the Reichsanstalt, which points out that two kinds of Weston standard cells of almost, but not quite, the same e.m.f. should not be put in the market.—Lond. *Eng'ing,* Nov. 25.

Alternating-Current Measurements.—In the report of the Reichsanstalt for 1909 it is stated that it has been proved that the constants of the quadrant electrometer determined by direct-current measurements remain valid for alternating-current measurements when a phase difference exists in the potentials of the needle and the quadrants. In the course of this research the determination of the constants has been reinvestigated and several new connection systems have been described. In transformer tests difficulties were experienced in splitting a resistance on the high-tension side. Although the resistors on the two branch circuits were of the same type, phase differences arose in the potential owing to differences in the capacities of the resistors as regards the earth and one another; to cure this trouble the resistors are provided with metallic sheaths charged to definite potentials. The self-induction of bifilar standard resistors (tapes) has been determined by the aid of the electrometer with high-frequency currents.—Lond. *Eng'ing,* Nov. 25.

Meter.—An official article of the Reichsanstalt concerning an induction meter for single-phase and three-phase currents submitted by the Allg. Elek. Ges. The construction is described and illustrated, and the method of calibrating is described.—*Elek. Zeit.,* Nov. 24.

Measuring Strength of Magnetic Fields.—W. Peukert.—A translation of his recent German article on a new method for measuring the strength of magnetic fields.—Lond. *Electrician,* Nov. 25.

Reichsanstalt.—A report of the work of the Reichsanstalt during the year 1909. Those parts which deal with electrical engineering are dealt with separately in the Digest.—Lond. *Eng'ing,* Nov. 11 and 25.

Telegraphy, Telephony and Signals.

Bookkeeping.—J. F. Schaer.—A paper in which the author explains the commercial and mathematical principles of the double-entry bookkeeping system and its application to engineering problems.—*Elek. Zeit.,* Nov. 24.

Book Reviews.

Einführung in die Elektrotechnik. By Dr. C. Heinke. Leipzig: S. Hirzel. 501 pages, 512 illus. Price, 14 marks.

An elementary textbook in electrical engineering for the use of students in the Technische Hochschule of Munich. The main subjects treated are: (1) Introduction. (2) Electromotive sources. (3) Direct-current dynamos. (4) Alternators. (5) Electric power and energy. (6) Electric motors. (7) Electric heating. (8) Electric lighting. (9) Storage batteries. (10) Measuring instruments. (11) Conductors. The book is systematically prepared and the method of treatment is very clear and practical. The illustrations are excellent and ample. The treatise appears to be one of the best elementary textbooks on direct-current and alternating-current engineering in the German language.

THE SHOT-FIRER'S GUIDE: A Practical Manual on Blasting and the Prevention of Blasting Accidents. By Wm. Maurice. London: The Electrician Printing & Publishing Company. New York: D. Van Nostrand. 212 pages, illus. Price, $1.50.

The elementary theory of explosion, the properties of explosives and different types of fuses, rules for blasting and precautions to be taken in order to avoid accidents are all brought out in answers to a selected list of questions arranged to develop the subject logically.

ÜBER ELEKTRONEN. By Dr. W. Wien. Leipzig: B. G. Teubner. 39 pages, 2 illus. Price, 1.40 marks.

This little pamphlet is an essay on electrons and the electronic theory of Prof. Dr. W. Wien, of Würzburg University. It sets forth the principal facts thus far experimentally deduced in researches on electrons and in simple language readily followed by any scientist who has not given special attention to this new and rapidly developing field of physics. The author is to be congratulated on presenting so relatively full and clear a statement of the subject in such a small number of pages.

New Apparatus and Appliances

SANITARY WATERPROOF TRANSMITTER.

The accompanying illustration shows a new form of telephone transmitter, the invention of Mr. Felix Gottschalk, who has been closely identified with the electrical industry for the past twenty-five years, particularly with the branches of telegraphy and telephony. Eight patents relating to the transmitter were issued Dec. 6 and there are two patents of earlier date relating to the same device.

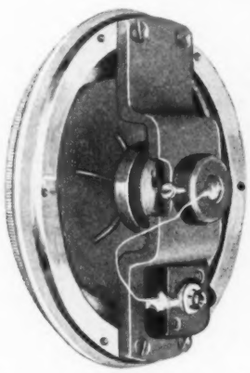


Fig. 1—Transmitter with Rear Casing Removed.

Fig. 2—Transmitter with Perforated Guard Removed.

Fig. 3—Transmitter with Perforated Guard in Place.

The transmitter consists of the usual shaped casing in two parts, and a granular carbon resistance cup with front and rear electrode of the standard type. The usual diaphragm is replaced by a metallic disk, which is put under adjustable tension by means of a screw ring. The front electrode or resistance cup is connected with the diaphragm by spired legs soldered to it and attached centrally to a hub, a threaded aperture of which engages the front electrode stud. The rear electrode has a solid back with the usual bridge connection, and is insulated from the bridge by means of a fiber bushing, while the front electrode is in circuit with the casing.

The flaring mouthpiece of the ordinary type of transmitter is replaced by a perforated guard covering the entire face of the diaphragm, the sides of which have a bayonet slot engagement with the casing, to which it is finally secured by a screw at the periphery. The damping is accomplished by means of a flexible ring at the circumference of the inner side of the diaphragm, which is held in place by a flat metal ring secured by a projecting rib. The sections of the casing are made watertight by means of screws through the front casing engaging in lugs soldered within the wall of the back casing, a washer being interposed between the two sections. Should any water pass through the extremely small perforations in the guard it cannot pass beyond the diaphragm into the chamber containing the working parts. For cord connection the insulating block attached to the bridge is provided with a socket opening to the rear, the walls of which are split and constricted; the aperture in the rear casing is fitted with a tubular boss externally threaded and projecting beyond the surface, over which fits a cup-shaped rubber cap provided with an aperture for the terminal cord. This cap is fitted with a soft-rubber gasket, and when tightened forces the tip of the connecting cord into the constricted socket, thus making a good contact and effectually sealing the working parts of the transmitter against water and atmospheric influences. By this method the wire tip is connected without taking the transmitter apart. By means of a thumb-screw attachment the transmitter can be clamped to any suitable support.

Tests on the transmitter were made by Professor George C. Shaad, professor of electrical engineering of the University of Kansas, in comparison with a standard commercial transmitter carefully selected with regard to its transmission properties. An artificial line in section was used, the arrangement being such that the two instruments compared could be quickly interchanged. The result was that for all practical purposes the transmission of the two instruments was the same over various sections of the line, the total length of which was 750 miles, thus showing that the perforated guard did not affect the operation of the transmitter.

Tests at low and high temperature were made without affecting the qualities of the instrument. One test consisted in placing the transmitter in water and gradually bringing it to a temperature of 150 deg., at which it was then tested and no change in the transmission qualities could be detected. In all the above tests the line was varied so as to give a comparison with the standard instrument on short, intermediate and long lines. After the above test under water at 150 deg. the instrument was opened and the working interior found to be entirely dry and free from moisture, although it had been entirely immersed for a period aggregating thirty minutes.

Some of the conclusions of Professor Shaad as to the advantages of the Gottschalk transmitter in comparison with the ordinary type are as follows: Elimination of the open, flaring

mouthpiece, thus making the instrument sanitary; with the mouth 3 in. away from the guard transmission was not impaired. The transmitter is effectually sealed against atmospheric influences, so that moisture cannot affect any of the interior parts, including the carbon chamber. The instrument does not have to be dissembled in any way in order to connect or disconnect it from a wall or desk set, and it contains no springs and all connections are rigid. Owing to the waterproof property, together with the fact that all exterior parts are metallic, Professor Shaad points out that it makes an ideal transmitter for use where the instrument is much exposed, as in public stations, on railways and in mines.

A CABLE-FORMING BOARD.

In order to make it easier for the electrical contractor who has had no experience whatever in installing intercommunicating telephones to install its inter-phones in an up-to-date manner the Western Electric Company is furnishing full-sized diagrams of cable-forming boards. These diagrams enable the contractor to make cable-forming boards for every variety of inter-phone sets.

The advantage of forming the cable is apparent to all those experienced in telephone work, but until recently its importance was not realized by many electrical contractors. Experience has shown that the very best plan to follow in cabling an interior telephone system is to form the cable at each telephone set so that each conductor or pair of conductors will be separated from the rest and sewed permanently into their respective

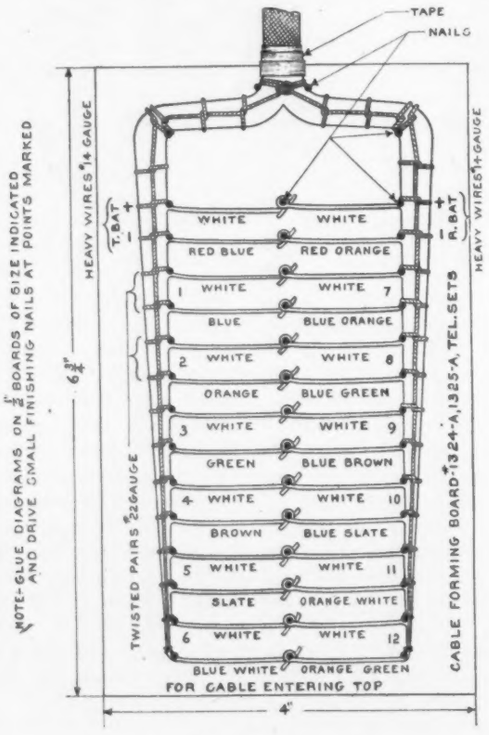


Fig. 1—Diagram of Board.

places by the means of extra stout twine made especially for the purpose. In this way every conductor is brought out of the cable at its proper place and there can be no disarrangement of the conductors due to later handling. This reduces the likelihood of the conductors being crossed to a minimum.

Fig. 1 shows a cut of a diagram which, as furnished, is first glued upon a board about ½ in. thick and then the board sawed along the edges of the diagram. This makes the board of the proper size for the different types of telephones noted on the diagram. At the points marked small nails are driven into the board and the wires are formed around the nails and sewed into place as indicated on the diagram.

A completely formed cable, sewed as it should be, is illustrated in Fig. 2. The proper twine used for the purpose is twelve-strand linen, as this provides sufficient strength for allowing the stitches to be drawn up extremely tight without the chance of breaking the twine. When the cable is completed it is lifted off the forming board and is then of the

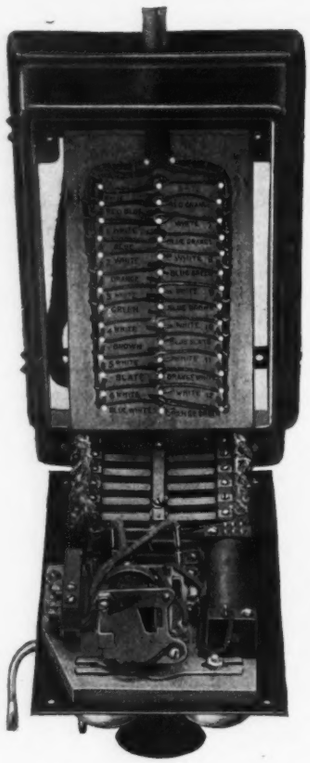


Fig. 2—Finished Board.

proper size, so that the conductors come out of the proper places to attach directly to the correct terminals in the telephone sets.

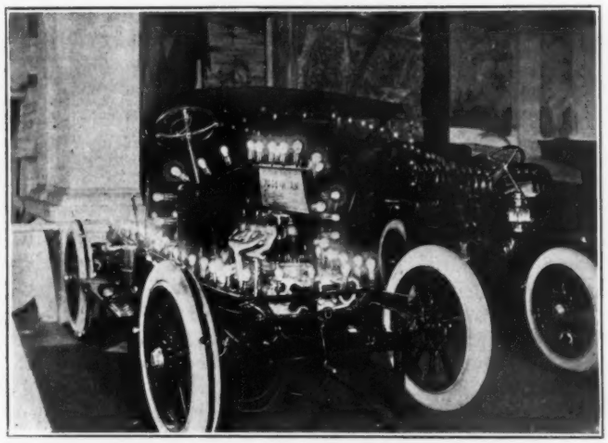
The use of these forming boards insures the continued satisfactory operation of an inter-phone system, as there is little chance of the apparatus itself getting out of order when properly installed.

SIGN LAMPS THAT WITHSTOOD PUNISHMENT.

Specialized types of incandescent lamps are sometimes perverted to strange uses. For example, lamps having flat-coiled filaments designed to give a downward distribution of light are sometimes seen suspended in long corridors; torpedo lamps are used for the illumination of display cases, miniature lamps are used to illuminate rooms, and so on. While in many instances lamps will not give satisfaction under conditions different from those for which they are primarily intended, it does not by any means follow that this is always the case, as the following account of sign lamps in automobile service will show.

The automobile here illustrated was exhibited at the Interstate Auto Show, Sioux City, Ia., in March, 1910. Outlining the body and dashboard of the machine were seventy-two 10-volt, 5-watt sign lamps, wired ten and eleven in series. Part of the time a pressure of 104 volts alternating was impressed on the circuit, and at other times a pressure of 110 volts alternating; this was due to the fact that electricity was supplied by two competing central stations. On one occasion, due to an accident, the potential at the lamps rose to double its normal value and was not lowered for three minutes.

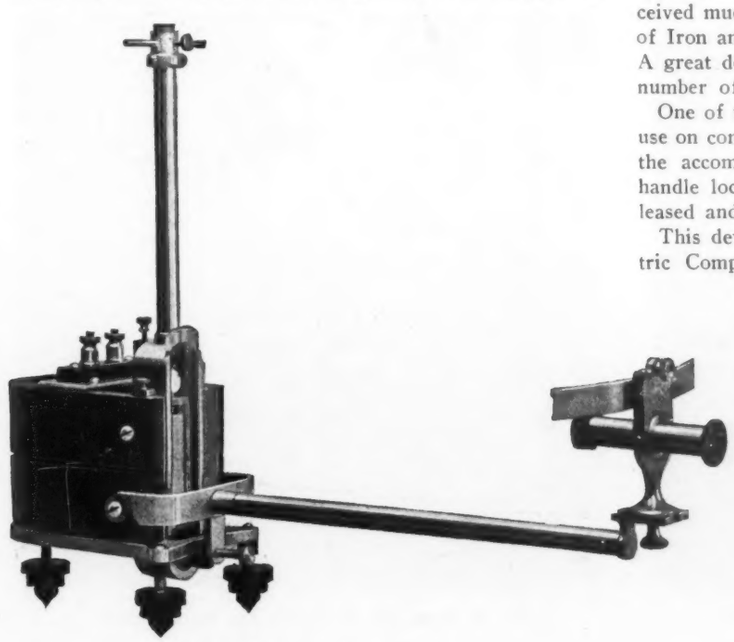
In connection with the show an automobile parade was given, during which the machine decorated with sign lamps was run over the streets for about three hours and a half. One might not expect that metal-filament lamps, such as are used normally in stationary-sign service, would be able to withstand the vibration incident to such a test, which was rendered especially severe by the fact that the lamps were not lighted during the parade. However, it is claimed that not one of the filaments was broken during any of the rough mechanical and electrical treatment above described. The "Mazda" sign lamps used for the decoration of the automobile were furnished by the Brilliant Electric Company, of Cleveland.



Automobile Outlined with Incandescent Lamps.

HIGH-SENSIBILITY GALVANOMETER.

The galvanometer shown herewith, made by the Thompson-Levering Company, Philadelphia, is of the high-sensibility type, having any sensibility up to 1600 megohms. It is composed of two units, the magnet and the tube with the coil system. The construction is such that the tube is easily removed. The magnet is carefully aged and hardened and insulated from earth by three leveling screws, highly insulated, and of a design which admits of rapid and easy adjustment. The system is ballistic and is provided with a removable damper which can be easily placed on the coil in order to make the system dead-beat. It is visible in its entirety through a glass window, which may be removed, and is readily accessible at all times for any adjustment desired or for the putting in of new upper and lower suspensions. The design throughout is such as to admit of ease and rapidity in cleaning the entire galvanometer, and parts where dust and dirt can collect can be quickly removed.



High-Sensibility Galvanometer.

The galvanometer coil is clamped by a special arrangement by a lever on the back of the tube, which insures the coil being held rigidly during transit and also renders it capable of quick and careful release when it is to be used. The contacts, which are made on platinum-iridium points, this material being superior to pure platinum, are automatically established when the tube is slipped into the pole-pieces in place in the magnet. The pole-pieces are so designed that the instrument shall give a deflection proportional to the current throughout the entire scale. Zero galvanometer adjustment is obtained by means of a level bar at the top of the tube, which gives a very sensitive adjustment; there is also a rack pinion adjustment on the scale. The telescope arms are insulated from the magnet and are supplied with a leveling screw to give the exact adjustment easily and readily.

The galvanometer lens system consists of an acromatic objective lens and acromatic Ramsden eye-piece, both non-hygroscopic. The objective is especially corrected for flatness of field, which is an important feature of the instrument. The eye-piece consists of two lenses, acromatic eye and single field. This combination of lenses, it is claimed, gives the highest results obtainable. The scale, which is a copper-plate reproduction of a standard millimeter scale, is one-half red and one-half black, thus facilitating the deflection readings.

SAFETY DEVICE FOR STEEL MILL CONTROLLING APPARATUS.

The importance of increasing the safety factor of electrical apparatus used in steel mills was one of the subjects which received much attention at the recent meeting of the Association of Iron and Steel Mill Electrical Engineers held at Pittsburgh. A great deal of discussion on safety devices took place and a number of new appliances were exhibited.

One of the simplest of these was a Kittredge safety lock for use on controllers and an application of this device is shown in the accompanying illustrations. Fig. 1 shows the controller handle locked in position, Fig. 2 showing the safety lock released and the controller handle free.

This device, which is manufactured by the Delta-Star Electric Company, of Chicago, Ill., consists of a hinged metal U-shaped piece fastened to the controller frame and so mounted as to engage or disengage the controller handle. When in the engaging position two projections on the safety lock inclose the controller handle, as shown in Fig. 1, and it is impossible to

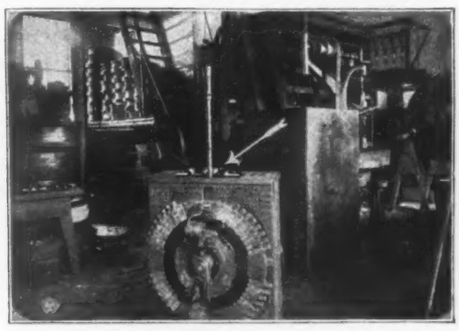


Fig. 1—Controller Handle in Position.

operate the controller until the lock is released by the use of a special key. An attendant can, therefore, securely lock the controller handle against operation by unauthorized persons, thus preventing possibility of starting up and causing injury to men or apparatus.

As an example of the necessity of using such devices one incident is recalled where an electrical accident caused a damage suit of $20,000. The case in point occurred at a mill where

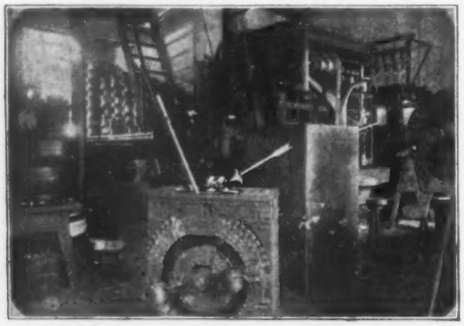


Fig. 2—Safety Lock Released.

an employee carelessly threw the controller handle to the first-notch position, where it remained. Later on another employee thoughlessly closed the main-circuit switch, and the result was a very bad accident, involving a suit in which the jury made the above-mentioned award.

INDUCTION MOTOR DRIVE IN AN ELASTIC-WEBB MILL.

The induction motor installation in the plant of the Mansfield Elastic Webb Company, Mansfield, Ohio, illustrates excellently the great advantages of the electric drive. The plant was originally run by steam, but when a large addition was made it was decided to install the electric drive. In the new building with electric drive there are thirty-five looms averaging forty shuttles each, while in the old plant, which is still run by steam, there are twenty-four looms averaging twenty-nine shuttles each. While the new plant has thus practically twice as many shuttles as the old one the cost of running is less than one-half the present cost of running the steam plant. The average bill for electrical energy in the new building for the past three months has been about $46 per month, while the bill for fuel gas, at 10 cents per 1000, to run the old plant was $43 per month, to which must be added the engineer's salary of $60 per month. In addition there are other charges against the old plant of $8.50 for water and oil; thus the cost of power in the old plant is $65 per month more than in the new plant, which has double the capacity. These figures are more remarkable from the fact that the boilers in the steam plant are fired with natural gas, which costs only 10 cents per 1000 cu. ft.

Owing to the higher speed possible on account of the uniform angular velocity of the motors an electrically driven loom has a considerably higher output than a similar steam-driven loom. Moreover, the electric looms are under more direct control; one operator who attends to two looms can instantly start or stop either loom from either end. Besides the reduced cost of producing power, as noted above, the other advantageous features are that the rooms are much lighter, due to the elimination of shafting and belting. This can be readily seen by comparing the accompanying illustrations giving a view down similar aisles of two practically identical rooms, except that one is equipped with belts and the other with motors.

Besides the main shaft it is also necessary to have a jack shaft across the building between each pair of looms. These shafts consume an enormous amount of power and are continually spoiling material through dropping oil and grease upon the finished product. It is also much easier to keep the new mill clean, and the fuzz given off by the looms is not continually being churned up and down by the swiftly moving belts and pulleys. Moreover, if a given machine is to be threaded up for special work and run day and night to fill an order, if a steam loom is thus used it is necessary to have the engineer present and to run a line of shafting throughout the entire mill. The motors in the mill were installed by the Ideal Electric & Manufacturing Company, Mansfield, Ohio. At present there are forty-seven Ideal motors in use, and the looms in the old mill are being electrically equipped one by one at intervals when the looms can be laid off a sufficient length of time. Most of the motors are 2 hp, although several are ¾ hp, and 3 hp are used on special looms.

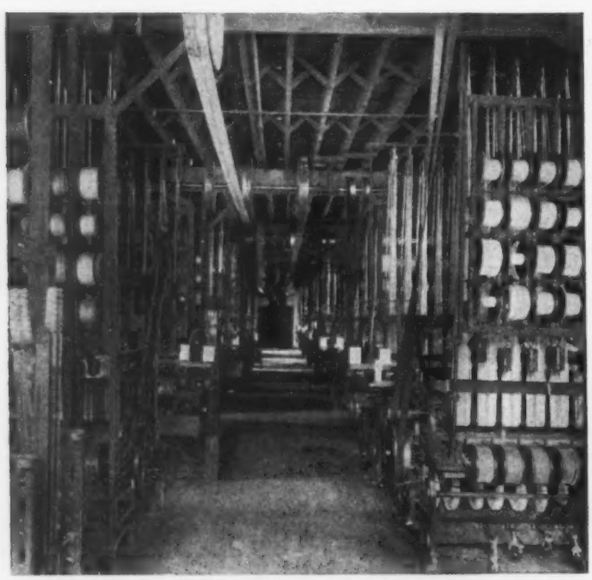


Fig. 1—Webb Mill Equipped with Belt Drive.

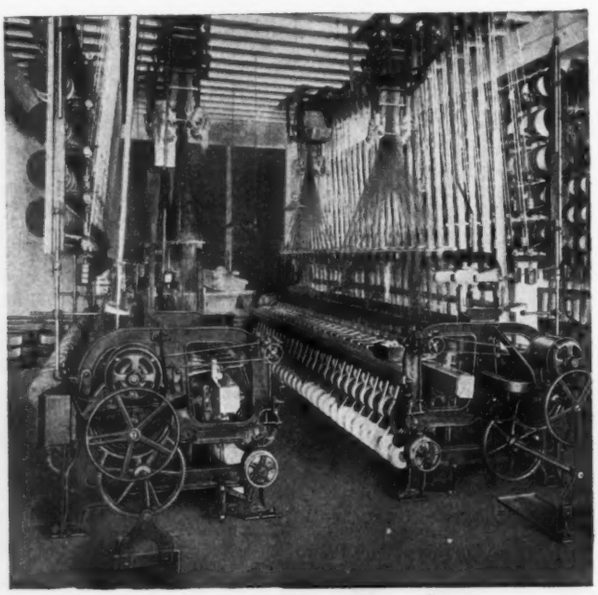


Fig. 2—Webb Mill Equipped with Motor Drive.

Industrial and Commercial News

THE WEEK IN TRADE.

WHILE it is undeniably true that the colder weather and the holiday demand have done something toward stimulating trade, business as a whole is not satisfactory. Jobbers and wholesalers report only a fair number of orders, and these are hardly up to expectations. There has been very little buying for spring delivery, and this is taken as an indication that retailers over almost all the country are extremely conservative. In industrial lines any changes that are worthy of notice are in the direction of reductions. Many mills, especially in the iron and steel industry, are laying off hands. It was stated last week that 15,000 steel mill employees had been laid off in the Pittsburgh district, and this is but an indication of the general condition. When hands are laid off in Pittsburgh every other industrial center is comparatively quiet. There have been few orders for rails and orders for car equipment have been very much lighter than is customary at this period of the year. Building material is quieter all around, structural iron is not in demand and the lumber markets of the Northwest are extremely dull. Collections are only fair, but are really as good as the state of business should warrant. Business failures for the week which ended Dec. 8, as reported by *Bradstreet's*, were 267, as against 217 the previous week, 259 in the same week of 1909, 298 in 1908, 284 in 1907, and 220 in 1906.

THE COPPER MARKET.

ELECTROLYTIC copper did not advance in price during the past week and, in fact, the demand was so small that it was only by artificial methods that old quotations were maintained. The monthly report of the Copper Producers' Association for November, which was published Dec. 8, showed that during the month there was a reduction in the accumulated supplies of copper in the United States of 8,872,000 lb. The surplus at the present time is 139,261,914 lb., which is the lowest that has been recorded since March. The most interesting feature of the Copper Producers' figures, however, is the fact that the production for the month of November fell off 7,116,000 lb., while deliveries fell off almost as much. This was not unexpected. The main interest in the figures that were offered by the Copper Producers' Association was in those of production. If the curtailment which had been promised in the summer went into effect there was some hope in the copper market that production would eventually drop below consumption. This curtailment was looked for in the reports of September and November, but it did not show up. While the curtailment went into effect in the actual operations of the mines in August, and to some extent in July, the method of arriving at the figures which has been adopted by the Copper Producers' Association does not allow such shortening of production to show up for two months. The figures given out by the association were: Stocks on hand Dec. 1, 130,389,069 lb., as compared with 139,261,194 lb. on Nov. 1; the production for the month of November was 119,353,463 lb., as compared with 126,469,284 lb. in the month of October; the domestic deliveries were somewhat shorter than those in the previous month, being figured at 60,801,992 lb., as against 67,814,172 lb. in the previous month. Exports, from which the government figures are taken, were almost the same as in the previous month. They were 67,424,316 lb., as against 68,186,912 lb. in October. The result of these figures is that, while the total deliveries of foreign and domestic trade were some 7,000,000 lb. less than in the previous month, the surplus stock showed a decrease of 8,872,845 lb. This is much the best statement that the Copper Producers' Association has made within the past six months, but it has not had the effect of advancing the price of copper. Electrolytic is still quoted at 12.87½c@13c, and copper has not been much cheaper than this during the present year. The condition of the market, however, is distinctly improved by the reduction in surplus stocks and by the continuance of a fair export trade. There was some little increase in the jobbing demand during the past week, but for the most part concessions below the quotations of the Metal Exchange were demanded. No large consumers were in the market and the majority of the sales were made for February and March delivery. In Europe standard copper has been offered at £56 16s 3d. Temporarily there seems to be a lack of European interest and there is little margin of profit in arbitrage transactions. Exports for the month of December, including Dec. 12, were 8818 tons. Imports so far this month have been at about the same average that they were during November. The daily call on the Metal Exchange Dec. 12 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.30	12.45	.....
December	12.30	12.37½	12.35
January	12.32½	12.45	12.40
February	12.37½	12.50	12.42½
March	12.42½	....	12.47½

The London market, Dec. 12, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	56 13 9	56 12 6
Standard copper, futures	57 10 0	57 7 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 •	53 7 6
Best selected	65 10 0	57 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Keokuk Power Company.—It is understood that the Keokuk Power Company has sold to a New York syndicate an issue of $10,000,000 of 5 per cent long-term bonds. British and Canadian capitalists are also interested in the underwriting of this issue. The proceeds of the sale of these securities will go to the construction of a dam across the Mississippi River at Keokuk and the building of a large power plant. This project has been under contemplation for a number of years, and it is expected that work will be completed within three years. The company has made a long term contract with the North American Company, by which it will furnish electrical energy to the North American properties in St. Louis. It will be remembered, as published in these columns, that the North American Company after having made this contract endeavored to have it canceled, but the Keokuk Power Company refused to permit this to be done. It is estimated that the total cost of the construction of the dam and power plant at Keokuk will be in the neighborhood of $16,000,000. The project was promoted by White & Company, 25 Pine Street.

Machado & Roller Company.—The sale of meters and circuit-breakers has been fairly large during the fall, although nothing extraordinary, according to reports made by Machado & Roller. The Roller-Smith Company, which is connected with the above-mentioned firm, has its plant at Bethlehem, Pa. The output of this plant is handled by Machado & Roller. It is said that this plant has been operating at about 80 per cent of capacity and that while the demand has been good it has at no time been insistent. The Machado & Roller firm has a number of selling agencies and branch offices all over the country. Within the present month a new branch office has been established in Chicago, which will be in charge of H. I. Shire. Another general office will soon be opened in Pittsburgh.

More Western Electric Property in Chicago Sold.—The Sanitary District of Chicago has agreed to purchase from the Western Electric Company property on the west bank of the South Branch of the Chicago River and extending from Polk Street south, needed for the purpose of widening and deepening the river, for the sum of $98,710, being at the rate of $6.35 per square foot for the 15,545 sq. ft. involved.

Illinois Traction Men Organize.—A call has been issued for a meeting of representatives of all of the traction lines in Illinois, to be held in Joliet. The purpose of this meeting is the organization of the Illinois Interurban Railroad Association. It is the plan of those who are back of the organization to secure co-operative action in legislative matters.

Officers of Public Service Corporations Without Implied Authority to Borrow Money.—The Kansas City Court of Appeals has decided that the vice-president and general manager of a central-station company has no implied authority to borrow money for the company, and the company is not liable on a note signed by him in the corporate name. The man who held the office of vice-president and general manager of such a company, operating in Missouri, signed the name of the company to a note for $4,200, and discounted it with a bank. When the bank sued the company the latter defended on the ground that the vice-president had no authority to make the note. It was held that this defense was good. In the opinion of the court it was said: "Defendant was a public service corporation, and as such belonged to the class denominated non-trading corporations. The implied powers of the general manager of such corporations do not include authority to borrow money and to emit the notes of the corporation. In banking and mercantile pursuits the necessities of business frequently demand quick action in the borrowing of money, and, to meet such emergencies, it is customary for the chief executive officer to be clothed with the power to borrow money on behalf of the corporation. That usage and custom have invested him with the implied power thus to bind the corporation. But with non-trading corporations, such as defendant, there are no such necessities and there is no reason for bestowing upon the executive implied authority to plunge the company into debt. The income and outlay may be forecast with reasonable certainty, and the pecuniary wants of the corporation supplied without recourse to emergent action. We conclude that the vice-president and general manager possessed neither express nor apparent authority to borrow money on behalf of the defendant, and that strangers dealing with him were bound to take notice of his lack of authority."

Westinghouse Electric & Manufacturing Company.—There was a meeting last week of the directors of the Westinghouse Electric & Manufacturing Company, in which Pittsburgh bankers took part. There appears to be a better feeling toward the company than there has been for a considerable time, and it is promised that an early dividend will be paid upon the common stock. While it cannot be said that November was a record-breaking month in the way of business at any of the Westinghouse plants, the volume of orders at all of them was greater than for the corresponding month of the last two years and the shipments were very satisfactory. At the Westinghouse Electric & Manufacturing Company it was reported that the November shipments represented an amount somewhat in excess of $3,000 000, whereas the shipments of the machine company were almost equal to those of October, which was one of the largest months in several years. The electric company is doing a very heavy business in small motors. As an indication of this, it might be well to mention that within the last two or three weeks the company has received orders for 1000 graphophone motors for the American Graphophone Company; 500 ¼-hp special alternating-current motors for the Electric Renovator Manufacturing Company; 500 1/8-hp motors for the 1900 Washer Company; 450 1/15-hp motors for the Wayne Manufacturing Company, and 624 ½-hp alternating-current motors for the Hobart Electric Company, of Troy, N. Y.

Manufacturers' Library.—The Commercial Bureau Company has established a manufacturers' library in the Hudson Terminals at 50 Church Street, New York City, which will accept catalogs of American manufacturers, classifying and filing the same and digesting them in card-index form for reference and consultation by buyers, manufacturers, engineers, contractors, purchasing agents and other consumers, both resident in and visitors to the metropolitan district. A committee of prominent manufacturers has consented to act in an advisory capacity in furtherance of the project, and has extended an invitation to manufacturers to take immediate steps to become identified with the work by placing their catalogs on file in the library. The total cost to the manufacturer will be $10 per year, for which sum he is entitled to have placed on file any or all of his catalogs, photographs, drawings, etc. This fee also includes the insertion in card-index files for buyers of a card giving a printed index of the original catalogs placed on file by the manufacturer. These card-index files are distributed to buyers and others interested in same for use in their own offices. Over 600 manufacturers have already accepted the invitation.

The Lathbury-D'Olier Company, Morris Building, Philadelphia, has been formed by the consolidation of two interests, both established in 1894. B. B. Lathbury, member American Society of Civil Engineers, formerly located in the Land Title Building, Philadelphia, has specialized in the design and construction of Portland cement plants, and has installed many plants throughout the United States and foreign countries. The D'Olier Engineering Company, formerly 119-21 South Eleventh Street, Philadelphia, mechanical and electrical engineer and manufacturer, has done extensive work in steam, electrical and hydraulic plants and industrial equipments in this country and abroad. The new company has established executive offices in Philadelphia and an office in New York. With enlarged shop facilities in Philadelphia the new firm will be enabled to carry on more extensive work than formerly.

Stavanger Electric Steel Works.—The Stavanger Shipwrecking Company, Norway, has recently offered subscriptions of stock to the amount of 450,000 kroner for the Stavanger Electric Steel Works. The purpose of the company is to buy steel scrap from several shipwrecking companies and manufacture high-grade steel by means of electricity. The works will be located at Jörpeland in Ryfylke. The Ryfylke Power Company has already been contracted with for delivery of 2500 hp electrical energy. The yearly production will be about 3000 tons. The plant is planned to be ready for operation in latter part of 1911.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at The Dalles, Ore.; Silver Springs, N. Y.; Wetumpka, Ala.; Uintah, Utah; Salina, Kan.; Chicago, Ill.; Solvay, N. Y.; Kingston, Ont., Can.; Stoughton, Wis.; Greenville, Cal.; Chehalis, Wash.; Lodi, Cal.; Georgetown, Tex.; Roberta, Ga.; Kiowa, Okla.; Bluffton, Ind.; Hartford City, Ind.; Dahlonega, Ga.; Columbus, Ohio; Hoisington, Kan.; Painted Post, N. Y.; Dublin, Ga.; Vancouver, B. C., Can., and Fresno, Cal.

Queens Borough Gas & Electric Company.—At an adjourned hearing before Commissioner Maltbie of the Public Service Commission of the First District last week Carleton Macy, president of the Queens Borough Gas & Electric Company, furnished information as to the number of meters in service in 1909 with the various amounts each meter totaled during the year. The hearing was adjourned.

Rateau-Smoot Turbine for Mill Work.—The Ball & Wood Company, Elizabethport, N. J., has taken a contract for furnishing and erecting for the French Worsted Company, Woonsocket, R. I., a 750-kw mixed flow Rateau-Smoot turbine and Smoot three-phase, 60-cycle generator, with direct-connected exciter, under a general contract with the Rateau Steam Regenerator Company.

Trump Turbines.—The Trump Manufacturing Company, of Springfield, Ohio, maker of water-power machinery, has recently shipped to the City of Idaho Falls, Idaho, for its municipal water and lighting plant seven large turbine units. The turbines for the lighting plant will drive vertical umbrella-type generators.

Edison Storage Battery Car.—The double-truck car equipped with Edison storage batteries which was described in our issue of Oct. 27 has been put into regular service upon the Erie Railroad. It is being operated on the Orange branch, and makes three trips daily between West Orange and Forest Hill.

Financial.

The Week in Wall Street.

LAST week was one of declines and of liquidation in the stock market. The fact that prices went off from two to five points was hardly so important as the fact that the entire tone of the market was lower and that the buying interest was distinctly less in evidence. As a matter of fact, Wall Street seems to have struck a position where liquidation is the program of every conservative trader. There is very little buying except that of speculators, and this is so weakly substantiated by cash resources that it makes very little impression upon the general condition of the market. During the past week there were few news happenings that should have had or did have any effect upon the market. The truth of the matter was that the market was weak, and that there were more sellers of stock than there were buyers. The result of this was that the average decline in prices was from two to five

points. For this decline there was no real reason, further than that it is generally understood that prices have been at too high a basis for the present condition of trade. Everybody knew that for many weeks during the fall the prices of stock were artificially upheld by manipulators. This condition, of course, could exist only so long as the manipulators were strong enough to hold up the market. It was generally believed that a decline was necessary, in order that prices of securities should reach a fair basis with the general commercial situation. Whether this basis has been reached as yet or not is the difference of opinion that now makes the market somewhat speculative. The bears declare that prices will go much lower, while the bulls are of the opinion that prices have already gone as far down as is necessary, and that we may look for a reaction either before the end of the year or early in January. In the meantime the money market continues to be entirely easy, and there are more offers of loans from the banks than there are borrowers. Quotations Dec. 12 were: Call, 3@3½ per cent; 90 days, 4 per cent. The quotations in the table are those of the close Dec. 12.

NEW YORK.

	Dec. 5.	Dec. 10.	Shares Sold.		Dec. 5.	Dec. 10.	Shares Sold.
All. Ch.	8⅛*	8½*	100	Int. Met., pf.	53⅞	53¼	28,650
All. Ch., pfd.	30⅛*	27½*	100	Mackay Cos..	90*	88*	300
Amal. Cop...	64⅜	63⅝	138,400	Mackay, C.,pf	74⅞	74½	225
Am. D. T...	20½*	20½*	———	Man. Elev...	140	138	1,011
Am. Loco....	36½	37*	3,960	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	105⅛	105*	300	N.Y.&N.J.Tel.	139¼*	139½	———
Am. Tel. & C.	80*	80*	———	Steel, com...	73¾	72¾	985,647
Am. T. & T..	139½*	141¾	10,625	Steel, pfd....	115¾	116⅜	6,390
B. R. T.....	74⅞	73¾	13,180	W. U. T....	70¼	71½	2,247
Gen. Elec....	151	153½	4,400	West'h, com..	67	66	3,840
Int.-Met.	19⅜	19¼	29,850	West'h, pfd.	122½*	120*	300

PHILADELPHIA.

	Dec. 5.	Dec. 10.		Dec. 5.	Dec. 10.
Am. Rys.....	42¾	42¾*	Phila. Elec.....	15⅝	15¾
Elec. Co. of A.....	11¾	11⅝*	Phila. R. T.....	18¼	18⅛
Elec. St. B'ty.....	47	48*	Phila. Trac.....	83*	83¼
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	43¼*	42½

CHICAGO.

	Dec. 5.	Dec. 10.		Dec. 5.	Dec. 10.
Chi. City Ry.....	170*	170*	Chi. Tel Co.....	123	122½
Chi. Rs., Ser. 1.....	92*	90*	Met. El. Co.....	20	20¾
Chi. Rs., Ser. 2.....	23⅛	23½	Met El., pfd.....	65	65*
Com. Edison.....	115	115*	Nat'l Car.....	123*	120*
Chi. Subways.....	4¼*	4⅛	Nat'l Car, pfd.....	119*	119*

BOSTON.

	Dec. 5.	Dec. 10.		Dec. 5.	Dec. 10
Am. T. & T.....	140	141¾	Mex. Tel.....	5	5*
Cum. Tel.....	145*	150*	Mex. Tel., pfd.....	6¼*	6¼*
Edison E., Ill.....	280*	284	N. E. Tel.....	138	138
Gen. Elec.....	152	153⅝	W. T. & T.....	16½	16
Mass. E. Ry.....	18*	18¼*	W. T. & T., pfd.....	90	90*
Mass. E. Ry., pfd...	85*	84			

*Last price quoted.
Shares sold for week Dec. 5 to Dec. 10.

FINANCIAL NOTES.

Philadelphia Traction Reorganization.—A plan for refinancing the Philadelphia Rapid Transit Company and the Union Traction Company has finally been agreed upon, and follows out the lines originally suggested by E. T. Stotesbury, a member of the firm of Drexel & Company. About two months ago Mr. Stotesbury was invited to take charge of the finances of the Philadelphia Rapid Transit lines. He agreed to enter the board and become the financial head of the companies if certain conditions were carried out. The directors of the company were inclined to oppose Mr. Stotesbury's conditions, and for six weeks negotiations have been carried on which have now finally resulted in an acceptable plan. The two boards of directors of the Union Traction Company and the Philadelphia Rapid Transit Company have agreed to recommend to the stockholders the guaranteeing of a $10,000,000 bond issue, provided that the Rapid Transit stockholders will make over to the Union Traction system the ownership of the Market Street elevated road. This will then be used as a collateral for the new bond issue. The stockholders' meeting of the two companies can only be held after sixty days' advertised notice, and therefore the new financing cannot be made effective until after this time. It is also necessary that the City Council of Philadelphia assents to the new plan. These meetings have not yet been called but will be within a few days. If the plan goes through, it is expected that the banking firm of Drexel & Company will place the $10,000,000 bond issue which is proposed. It is not expected that there will be any opposition from the stockholders of either company. With the approval of this financial plan, Mr. Stotesbury will enter the directorate of the Philadelphia Rapid Transit Company, and it is probable that he will insist upon some changes in that board.

Cities Service Company.—A meeting of the stockholders of the Cities Service Company, the new holding organization recently formed by Henry L. Doherty & Company, will be held next week, at which a permanent board of directors will be elected to take the place of the temporary board which has had charge of the company's affairs since the organization. Henry L. Doherty will be retained as president of the company. At this meeting it is expected that quarterly dividends of 1½ per cent on the preferred stock and ¾ of 1 per cent on the common stock will be declared. These dividends will be payable Jan. 1. It is announced that in the future dividends on the preferred stock will be paid monthly at the rate of ½ of 1 per cent, if the stockholders so desire. This plan of monthly dividends was adopted by Mr. Doherty in the Denver Gas & Electric Company, and has proved very popular. The earnings of the properties now held by the Cities Service Company during October and November were sufficient to show a surplus in excess of the amount required to pay all dividends.

Third Avenue Reorganization.—The Public Service Commission of the First District of New York last week declined to approve the reorganization plan submitted by the bondholders' committee of the Third Avenue Railroad Company. This is the second time that this plan has been overruled. The committee after the first decision asked for a rehearing as a matter of form, in order that the merits of the case could be carried into court. The decision of the commission last week puts the question in a position where it can be appealed to the courts without further hearings. In its second opinion disapproving of this reorganization the commission states: "It would be obviously unwise and useless to approve a plan which might mean another foreclosure and reorganization in a few years. This is the second time within ten years that the Third Avenue company has been in the hands of a receiver. It is time that a conservative plan were adopted, and upon sound principles, that another cataclysm will not be necessary."

Butte Electric & Power Company.—The earnings of the Butte Electric & Power Company for the twelve months ended Aug. 31 showed a surplus over and above all charges and preferred stock dividends equal to about 15 per cent on the $4,000,000 outstanding common stock. During the calendar year 1909 the company earned a surplus available for dividends of 17 per cent on the outstanding stock at that time, which was $3,500,000. The company at the present time is reporting monthly gains in earnings, and the outlook for the future is said to be very bright. By the completion of the 36,000-hp hydroelectric plant at Great Falls the company will be placed in an excellent position to take care of all demands. The Butte Electric & Power Company owns one-half of the capital stock of the Great Falls Water Power & Townsite Company. This latter company has a double transmission line from Great Falls to Butte and Anaconda, and its energy is taken by the Amalgamated and Anaconda Copper Companies.

Electric Consolidation in Boston.—Special legislation will be asked of the Massachusetts Legislature at the coming session for permission to bring about the consolidation of the Boston & Northern and the Old Colony Street Railway systems. These systems operate in the north and south sides of Boston, respectively. This consolidation is being engineered by P. F. Sullivan, president of the Boston & Northern company. The two companies have for many years been working under the same managers through a voluntary holding company—the Massachusetts Electric Companies. The consolidation will mean the union of more than 900 miles of street railway tracks in New Hampshire, Massachusetts and Rhode Island. The Boston & Northern system is capitalized at $11,000,000, and its latest report showed a property value of $24,709,205.

Detroit Edison Bond Issue.—The Detroit Edison Company has sent a circular to its shareholders announcing that the company has decided to issue $1,500,000 of its ten-year 6 per cent convertible bonds. This is the balance of an issue of $3,000,000 authorized by the shareholders last February. The proceeds of the new issue will be used for construction requirements, and to pay for as many of the convertible debentures due September, 1911, as shall not have been converted into stock by the present holders. The new bonds will be convertible between Feb. 1, 1913, and Feb. 1, 1919, at the option of the holders, into the stock of the company at par. The stockholders of record of Jan. 10, 1911, will have the right to subscribe to the new issue to the extent of about 25 per cent of their stock holdings.

Western Electric Company.—The Western Electric Company last week sold to Lee, Higginson & Company and other bankers $6,250,000 of its first-mortgage 5 per cent bonds. This puts into the market the entire authorized issue of $15,000,000 of bonds. Last January the company sold $5,000,000 of two year 4½ per cent notes, and pledged as collateral $6,250,000 of 5 per cent bonds. These bonds are now marketed in order that the notes may be retired in the coming January. So far as the financing of the Western Electric Company is concerned, the disposition of these bonds furnishes all the cash that is necessary for the operation of the company for years to come. The earnings of the company during the past fiscal year have been very large, but it was thought necessary to accumulate some additional working capital. The American Telephone & Telegraph Company owns 80 per cent of the Western Electric Company stock. At a meeting of the directors of the Western Electric Company last week an extra dividend of 2 per cent, payable Dec. 31, was declared upon the $15,000,000 outstanding stock. This was in addition to the regular dividend of 1 1/3 per cent. The company has changed its fiscal year, which heretofore has ended Nov. 30, to correspond with the calendar year, and its future reports will be made according to the calendar year.

Carolina Power & Light Company.—The earnings of the Carolina Power & Light Company for the twelve months which ended Oct. 31 were not only sufficient to meet all operating costs, taxes and charges, but left a balance equal to more than twice the amount required to pay interest charges on the company's $865,500 first-mortgage 5 per cent bonds. It is generally asserted by the managers of the company that the future of this property is very bright. The franchises which it owns extend for many years, a favorable contract has been made with the City of Raleigh for eight years, and the company has good contracts with Sanford and Jonesboro. In addition, the company has a number of contracts with cotton mills, some of which are of long duration. The present physical valuation of the property is estimated at $1,476,521.

Pacific Power & Light Company.—White, Weld & Company, 5 Nassau Street, New York, are offering $1,200,000 of the 7 per cent cumulative preferred stock of the Pacific Power & Light Company. This is the principal part of an authorized issue of $1,500,000. The Pacific Power & Light Company is a consolidation of properties serving eighteen communities in western Washington and Oregon and in Idaho. It operates both hydroelectric and steam plants, and furnishes energy for light and power. It also operates gas, water and railway properties. The Pacific Power & Light Company is controlled through stock ownership by the American Power & Light Company, which in turn is controlled by the Electric Bond & Share Company, an organization owned and controlled by the General Electric Company.

Northern Ohio Power Company.—The directors of the Northern Ohio Traction & Light Company, of Akron, Ohio, have prepared plans for the organization of the Northern Ohio Power Company, which will control the new power plant which will soon be erected in the neighborhood of Cuyahoga Falls. The new company will be capitalized at $3,000,000 stock and $3,000,000 bonds. The cost of the new power station will be approximately $1,500,000. The new company will be owned by interests identified with the Northern Ohio Traction & Light Company.

Southern & Atlantic Telegraph Company.—The Southern & Atlantic Telegraph Company, which has lines extending from Washington through the Southern and Gulf States, and which is under a 999-year lease to the Western Union Company, held its annual meeting last week and elected Theodore N. Vail, U. N. Bethel, Newcomb Carlton and H. B. Thayer directors to succeed R. C. Clowry, J. C. Barclay, George J. Gould and J. T. Terry. This is simply carrying out the recent change in management in the Western Union Company.

Long Acre Electric Light & Power Company.—The Supreme Court of New York last week decided that the $350,000,000 mortgage which was claimed to exist against the Long Acre Electric Light & Power Company was invalid. This clears the way for the Long Acre company to proceed with its business. Another court last week decided that the Public Service Commission must consider the Long Acre company's application for the issuance of stocks and bonds.

Burlington (N. J.) Electric Light & Power Company.—The Public Service Corporation of New Jersey last week purchased the entire capital stock of the Burlington Electric Light & Power Company. This company was capitalized at $25,000. The company secured just before its purchase a fifty-year franchise from the City of Burlington, N. J.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 3.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable Jan. 1.

Chattanooga Railway & Light Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Cincinnati Gas & Electric Company, quarterly, 1¼ per cent, payable Jan. 2.

Niagara Falls Power Company, quarterly, 2 per cent, payable Jan. 2.

Phelps-Dodge & Company, quarterly, 2½ per cent, extra, 2 per cent, both payable Dec. 30.

Portland (Ore.) Railway, Light & Power Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Providence Telephone Company, quarterly, 1 per cent, payable Jan. 2.

Sao Paulo Tramway, Light & Power Company, Ltd., quarterly, 2½ per cent, payable Jan. 2.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Union Traction Company, Philadelphia, semi-annual, 3 per cent, payable Jan. 2.

United Traction & Electric Company, Providence, R. I., quarterly, 1¼ per cent, payable Jan. 2.

Western Electric Company, extra, 1⅓ per cent, payable Dec. 31.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Commonwealth Power, Railway & Light Company:					
October, 1910	$425,742	.....	$201,369	.....	$79,336
October, 1909	389,368	.....	187,072	.....	68,337
Lowell (Mass.) Electric Light Corporation:					
October, 1910	38,256	$21,533	16,723	.....	12,486
October, 1909	33,843	17,377	16,466	.....	12,321
Keystone Telephone Company, Philadelphia:					
November, 1910	96,474	48,105	48,369	$24,392	23,977
November, 1909	91,851	45,611	46,140	24,634	21,606
Kings County Electric Light Company:					
November, 1910	403,934	178,781	225,153	117,777	107,376
November, 1909	346,815	165,337	181,478	99,461	82,017
Massachusetts Electric Companies:					
Year ended Sept. 30, 1910	8,560,449	5,360,295	3,200,654	1,792,936	1,407,717
Year ended Sept. 30, 1909	8,052,355	5,158,396	2,903,958	1,778,128	1,125,829
New York State Railways Company:					
Quarter ended Sept. 30, 1910	947,265	559,472	387,793	144,898	304,274
Quarter ended Sept. 30, 1909	862,240	521,924	340,316	105,940	261,924
North Shore Electric Company:					
October, 1910	1,386,062	907,556	478,506	212,323	42,752
October, 1909	1,005,432	600,994	404,438	190,354	35,932
Pacific Coast Railway Company, San Luis Obispo, Cal.:					
October, 1910	804,850	634,570	170,279	.....	.....
October, 1909	758,929	601,393	157,536	.....	.....
United Railroads of San Francisco:					
October, 1910	670,295	387,811	282,484	.....	.....
October, 1909	733,766	402,537	331,229	.....	.....
United Railways of St. Louis:					
October, 1910	1,041,837	671,345	370,492	232,654	141,563
October, 1909	1,035,624	627,968	407,656	232,267	179,032

General News

Construction News.

BIRMINGHAM, ALA.—The City Council has granted the Coosa River Development Company a thirty-year franchise to supply electricity in Birmingham. Under the terms of the franchise the company is to have its plant in operation within three and one-half years and the maximum rate for electrical service is not to exceed 8 cents per kw-hour, with a discount of 12½ cents for payment within 10 days. The company also agrees to furnish arc lamps to the city at a price not exceeding $50 each per year.

GADSDEN, ALA.—Louis Hart, owner of the Bellevue Hotel, a summer resort located on Lookout Mountain, is reported to have completed arrangements for organizing a company to construct an electric railway up the mountain. It is stated that capital stock to the amount of $50,000 has been subscribed.

WETUMPKA, ALA.—The town of Wetumpka has engaged the Solomon-Norcross Company, engineers, of Atlanta, Ga., to make investigations and submit a report for improvements and extensions to the municipal electric light plant and water-works system and to prepare plans and estimates for a sewer system.

DOUGLAS, ARIZ.—The Western Construction Company, of Wichita, Kan., is reported to have submitted a proposition to the Chamber of Commerce, in connection with the irrigation of about 10,000 acres in this section. The company proposes to install pumping plants and furnish water to the landowners.

PHŒNIX, ARIZ.—Plans are being considered by S. H. Mitchell and associates for the construction of an electric railway between Phœnix and Glendale, a suburb, for which surveys have been made and most of the right-of-way secured.

NASHVILLE, ARK.—The Nashville Ice, Coal & Light Company has been granted a franchise by the City Council for a franchise to construct and operate an electric light plant in Nashville. It is understood that equipment for the proposed plant has already been purchased.

BODIE, CAL.—The Hydro-Electric Company is reported to have contracted for a 2500-hp Pelton impulse wheel and Pelton governor to operate under a 680-ft. head, and for an Allis-Chalmers generator to be installed at its plant in Bodie, Cal.

BRIDGEPORT, CAL.—The Board of Supervisors has granted the Hydro-Electric Company a franchise to erect transmission lines over the roads and highways of Mono County for the transmission of electricity for lamps and motors; also for the erection of telephone and telegraph lines.

FRESNO, CAL.—S. N. Griffith, promoter of the Fresno-Clovis electric railway, is reported to have made arrangements to secure energy for operating the proposed railway from the San Joaquin Light & Power Company, of Fresno. It is understood that contracts have been placed with the General Electric Company, of San Francisco, Cal., for transformers, etc., at a cost of about $30,000. Work will begin on construction of the railway as soon as franchise to enter the city is secured.

FRESNO, CAL.—Preparations are being made by F. S. Granger, promoter of the Fresno-Hanford Interurban Railroad, for the construction of the proposed railway, work on which will begin in the near future. The company is planning to erect a power plant near Fowler to furnish electricity for the railway. It is expected to develop about 1500 hp. The cost of the proposed railway is estimated at about $4,000,000. J. B. McDonald, superintendent of construction of the Hudson Counties Company, will have charge of the work.

GREENVILLE, CAL.—The Indian Valley Light & Power Company is reported to be contemplating increasing the output of its power plant and extending its transmission lines in the near future. It is understood that the lines will be extended to Taylorsville, Crescent and Seneca.

LODI, CAL.—Bids opened by the Trustees for the installation of a municipal electric light plant on Nov. 29 were rejected as none came within the amount of the appropriation. The specifications will be amended so as to provide for less expensive equipment. Most of the bids exceeded $8,000 and the trustees have but $4,000 to expend.

LOYALTON, CAL.—The City Trustees are reported to be considering the question of installing a new lighting system.

MONROVIA, CAL.—J. H. Holman, managing director of the new U. S. Grant Hotel, at San Diego, and W. R. Staats, of Pasadena, are contemplating the construction of an electric railroad to the summit of Mount Wilson in the near future.

MONTEREY, CAL.—The Pacific Gas & Electric Company, of San Francisco, Cal, has recently absorbed the plant and holdings of the Monterey County Gas & Electric Company, of Monterey. In connection with the deal comes the news of an extension by San Francisco capitalists of the Monterey electric railway to Salinas, twenty miles in length. Work will begin at once on construction of the proposed railway. W. H. P. Hill, manager of the present Monterey County Gas & Electric Company, will have charge of the Pacific Gas & Electric Company's new holdings.

OAKLAND, CAL.—It is reported that negotiations are under way for the absorption by the Pacific Gas & Electric Company of the Suburban Light & Power Company, of Oakland, Cal. The holdings of the Suburban company are estimated at about $1,000,000. The company supplies electricity for lamps and motors in Haywards, San Leandro, Niles, Irvington, Newark, Elmhurst, San Lorenzo, Pleasanton, and other Almeda County towns.

PIEDMONT, CAL.—Steps have been taken by Hugh Craig, president of the Board of Trustees, for establishing a municipal electric light plant in Piedmont. It is proposed to erect a distributing system and purchase energy from a private corporation to operate same.

RIVERSIDE, CAL.—Plans have been prepared by the Riverside Portland Cement Company for additions to its plant at Crestmore, which will include the installation of two new kilns, three ball mills and two tube mills. The company is also considering the erection of several new buildings for handling and storing cement. It is understood that the company expects to install considerable new equipment.

SANTA ROSA, CAL.—The contract for grading the proposed Santa Rosa & Clear Lake Scenic Electric Railroad, extending from Santa Rosa to Clear Lake, fifty-six miles in length, has been awarded to the Santa Rosa & Clear Lake Construction Company.

SUSANVILLE, CAL.—The Lassen Water, Light & Power Company is reported to have placed contracts for an additional unit for its plant, including a Pelton water wheel and a General Electric generator.

VALLEJO, CAL.—Sealed bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until Jan. 10, 1911, for furnishing an electric traveling crane at the Navy Yard, Mare Island, Cal., under schedule No. 3170.

DENVER, COL.—The Denver & Intermountain Railway, operating between Denver and Golden, has been purchased recently by the Denver Realty Company. The road has been in receiver's hands for some time. The company supplies an electric railway passenger service and a steam freight service. W. G. Evans, J. A. Beeler and W. H. Moffat are interested in the Denver Realty Company.

MANZANOLA, COL.—The Pueblo & Suburban Traction & Light Company, of Pueblo, Col., is reported to be contemplating extending its transmission lines to Manzanola to supply electricity for lamps. The company, it is understood, is considering extending its electric railway down through the valley in the near future.

SELBYVILLE, DEL.—The Town Council is reported to have granted a franchise to an electric light company to install an electric lighting system in Selbyville.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Commissioners for the District of Columbia, Washington, D. C., until Dec. 27 for wiring and apparatus for a time and signal bell system for the Western High School and for the McKinley Manual Training School, of Washington, D. C. Proposal forms, specifications and necessary information may be obtained upon application to the property clerk of the District of Columbia, Room 320, District Building, Washington, D. C. Cuno H. Rudolph, John A. Johnston and William V. Judson are commissioners.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Dec. 28, for furnishing electrical supplies under proposal No. 495. Captain A. S. Cowan is disbursing officer.

AUGUSTA, GA.—The Augusta Railway & Electric Company has applied for a charter to extend its railway to the city wharf on the Savannah River. It is reported that the company is contemplating other extensions to its railway. James U. Jackson is vice-president.

COLUMBUS, GA.—The contract for the machinery and electrical equipment for the new manufacturing plant of the Meritas Mills has been awarded to Deronda Levy, of Columbus, Ga.

DAHLONEGA, GA.—Plans are being considered by the Cedar Mountain Land Company for establishing an electric light plant to provide electricity for lighting the hotels, cottages, etc. H. R. Robertson, 727 Candler Building, Atlanta, Ga., is secretary and general manager.

DUBLIN, GA.—At an election held Dec. 6 the citizens voted to authorize an issue of $30,000 in bonds, the proceeds to be used for improvements to the water and light plant and for paving streets.

LAFAYETTE, GA.—Bids will be received by D. W. Herndon, Mayor, until Dec. 20 for $12,000 electric light bonds and $28,000 water-works bonds.

MACON, GA.—A movement is on foot to secure a reduction in the cost of street lighting or to install a municipal plant for lighting the streets only.

McDONOUGH, GA.—The question of establishing a municipal electric light plant in McDonough is reported to be under consideration.

ROBERTA, GA.—Arrangements are being made for the installation of an electric light plant and water-works system in Roberta, including the building of a concrete dam at a cost of $10,000. The cost of the equipment is estimated at $7,000. It is understood that bids for the work will be called for in about sixty days. W. J. Marshall, R.F.D., Lizella, Ga., is engineer in charge.

ROME, GA.—It is reported that negotiations are under way between the Rome & Northern Railroad Company, the Chattanooga Southern Railroad Company and the Chattanooga Railroad Company, recently incorporated, whereby the last named company proposes to use the tracks of the Chattanooga Southern Railroad to Trion and the Rome Northern Railroad to Rome, and also proposes to build an extension between Rome and the Seaboard Air Line Railway, and to use the latter road to Atlanta. The company is planning to provide an interurban service with motor-driven trains.

MULLAN, IDAHO.—Arrangements are being made by the Snowshoe Mining Company for the installation of a motor-driven air compressor, contract for which has already been placed. It is understood that other improvements will be made later.

SALMON CITY, IDAHO.—The Lemhi Telephone Company has been granted a franchise to install a telephone system in Salmon City.

WARDNER, IDAHO.—The Washington Water Power Company, of Spokane, Wash., has completed its new substation at Wardner. The new station will have an output of 1500 kw and will supply electricity to operate the machinery in the mills and ore-handling plants of the Bunker Hill and Sullivan Mining Company.

CHICAGO, ILL.—The installation of two 25,000,000-gal. electrically driven turbine pumps as an auxiliary to the present steam reinforced pumping engines at the Twenty-second Street pumping station is reported to be under consideration by the city. John Ericson is city engineer.

CHILLICOTHE, ILL.—It is reported that the Economy Light & Power Company, of Joliet, Ill., is negotiating with local parties to supply electricity to operate the pumping station in the Partridge and Hennepin Levee and Drainage Districts.

DECATUR, ILL.—The Decatur & Southern Traction Company has filed a notice with the Secretary of State showing an increase in capital stock from $25,000 to $1,500,000. Announcement has been made that the division from Decatur to Witt, sixty-eight miles in length, will be built first, after which the railway will be extended through Coffeen and Greenville to St. Louis. A belt line, one mile in length, around the southwest part of Decatur, connecting with the belt line of the Illinois Traction system, is part of the project. Peter Chase is president of the Decatur & Southern Traction Company.

EASTON, ILL.—It is reported that F. H. Conroy and Roy Holly will apply to the Village Board for a franchise to establish an electric light plant in Easton.

NAPERVILLE, ILL.—The Inter-State Telephone Company has been granted a twenty-five year franchise by the City Council, under the terms of which the company is to pay the city 5 per cent of its gross rental earnings after ten years from Jan. 1, 1911.

PEORIA, ILL.—It is reported that the citizens are contemplating the purchase of the cereal sugar plant to be used in connection with the combination electric light plant and pumping station for the water-works system to be installed.

ST. CHARLES, ILL.—The Business Men's Association is reported to have awarded the contract to install fifty-four ornamental lamp-posts on Main Street to the McFell Electric Company, of Chicago, Ill. Each post is to carry three 60-watt tungsten lamps.

ANDERSON, IND.—Suit has been filed against the Citizens' Heat & Light Company, of Elwood, asking for a receiver and for forfeiture of its charter. The suit was brought against the company owing to its failure to pay back $10,000 deposited by its customers for meters demanded by its predecessors.

BLUFFTON, IND.—The City Council has voted to make improvements to the municipal electric light plant, including the installation of a new engine and other apparatus.

BRAZIL, IND.—The City Council is reported to have taken steps toward the establishment of a municipal electric light plant in Brazil.

BROOKVILLE, IND.—Separate bids will be received by the Board of Commissioners of Franklin County, Brookville, Ind., until Jan. 19, for electrical work in connection with repairing and remodeling the county court house in Brookville, plans and specifications for which are on file at the office of the county auditor and at the office of Elmer E. Dunlap and Marshall E. Van Arman, architects, 909 State Life Building, Indianapolis, Ind.

FORT WAYNE, IND.—The Bass Foundry & Machine Company is installing a new engine of the Corliss type and a 200-kw generator to provide electricity for lamps and motors for its entire plant.

HARTFORD CITY, IND.—Arrangements are being made by the Hartford City Lighting Company for the construction of a new power station and installation of new equipment at a cost of about $35,000. The company has recently made extensive improvements and extensions to its distributing system involving an expenditure of about $30,000.

JEFFERSONVILLE, IND.—The Jeffersonville Water, Light & Power Company is contemplating making improvements to its electric plant.

LAPORTE, IND.—The Chicago-New York Air Line Traction Company is reported to have contracted with the Northern Indiana Gas & Electric Company for energy to operate its Laporte-Gary division for a term of ten years. A large substation will be erected at Goodman.

LINTON, IND.—Suit has been brought against the City Council by Arthur Simms, a taxpayer, asking that the Council be restrained from selling the municipal electric light plant. The city purchased the plant about ten years ago, and at present it is leased to S. V. Parrott, of Indianapolis, Ind. The lease expires March 1, and the city authorities are considering the advisability of selling the plant, as it will require extensive repairs to place it in order to supply satisfactory service.

PARKER CITY, IND.—Preparations are being made by the Eastern Indiana Telephone Company for rebuilding its local telephone system, which will include the erection of a new exchange building, replacing wires with cables and other improvements. Earl Rucker is general manager.

PORTER, IND.—The Town Council has granted the South Shore Electric Railway permission to construct an electric railway from Porter to the south shore main line of the Porter, Chesterton & South Shore Railway Company.

ATLANTIC, IA.—At an election held Dec. 5 the proposition to issue $50,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant, was carried.

BELLE PLAINE, IA.—It is reported that work has commenced on the construction of a municipal electric light plant in Belle Plaine. The cost of the proposed plant is estimated at about $20,000.

COLFAX, IA.—The Iowa Telephone Company has awarded the contract for the installation of an underground conduit system in Colfax to the Ryan Construction Company, of Davenport, Ia.

COLUMBUS JUNCTION, IA.—The city authorities are considering the question of granting a franchise for the installation of an electric light plant in Columbus Junction.

ELDORA, IA.—The Park Dam Power Company, which is constructing a large dam across the Iowa River and a power plant and electric system in Eldora, is reported to have purchased the dam at Steamboat Rock, which will supplement the dam now being erected here. E. H. Lundy, George W. Wood and A. H. Latimer, of Mason City, Ia., are interested in the Park Dam Power Company.

KEOKUK, IA.—The Keokuk Power Company is reported to have sold bonds to the amount of $10,000,000, the proceeds of which will be used for the construction of a large dam across the Mississippi River and a large power plant at Keokuk, Ia. It is expected to have the work completed within three years.

LOGAN, IA.—The citizens are reported to be considering the question of installing a municipal pumping plant, work on which will begin in the spring.

HAMBURG, IA.—The proposition to grant a franchise to install an electric light plant in Hamburg will soon be submitted to a vote.

SIOUX CITY, IA.—Plans have been prepared for the construction of a building, 100 ft. x 150 ft., five stories high, for the Johnson Biscuit Company, of Sioux City, Ia. The building will be equipped with an air purifier laundry, electric lighting plant, telephone system, fire sprinkler system, icing trolleys, etc. Orders have been placed for some of the machinery, but engines, boilers, etc., have not yet been decided upon.

VALLEY JUNCTION, IA.—Preparations are being made by the Iowa Telephone Company for the erection of a new telephone exchange building in Valley Junction, bids for construction of which will soon be called for. At present the Hawkeye Telephone Company operates the Valley Junction system under lease secured from the Mutual Telephone Company before the Iowa company purchased the independent system in Iowa.

WEBSTER CITY, IA.—The Fort Dodge, Des Moines & Southern Railroad Company is contemplating the construction of an electric railway in Webster City, for which a franchise will soon be applied for.

HOISINGTON, KAN.—The Hoisington Electric & Ice Company is reported to be preparing plans for enlarging its power plant, the cost of which is estimated at $15,000. J. R. Murphy is superintendent.

NEODESHA, KAN.—The contract for the construction of the proposed municipal electric light plant is reported to have been awarded to the Squire Electric & Construction Company. The equipment will include a 150-hp Monarch engine and a 100-kw generator, switchboard, etc. The street lighting system will consist of forty-four arc lamps.

SALINA, KAN.—It is reported that the People's Light, Heat & Power Company is contemplating using water-power to operate its plant. Surveys are now being made with a view of utilizing an old dam on the Smoky Hill River, a few miles out of Salina.

BARBOURVILLE, KY.—Local capitalists have leased the plant of the Barbourville Electric Light & Power Company. A new contract has been made with the city. Allory Smith will have charge of the plant.

DAISY, KY.—The Daisy Telephone Company, recently organized with a capital stock of $1,000, is reported to be planning to erect a telephone system in this county, work on which will begin immediately. Charles Franck, R. H. Madden and others are interested in the company.

LEXINGTON, KY.—Plans are being prepared for the construction of a new power plant in Lexington. A company will be organized under

the name of the Fayette Light Company to construct and operate the plant. The company will be capitalized at $500,000 and will supply electricity for lamps and motors in this city. A. H. Peck is general manager.

FREDERICK, MD.—The Frederick Railway Company has recently installed a 750-hp engine and 2 400-kw alternating-current generator in its power house and has also equipped three rotary substations complete. Oscar B. Coblentz is chief engineer.

BOSTON, MASS.—The Boston Elevated Railway Company, of Boston, Mass., is reported to have purchased the property of the George Lawley & Sons Corporation, at South Boston. The elevated company is planning to build a large power plant at South Boston to supply electricity to operate its railway system, including subways, elevated and surface lines.

GARDNER, MASS.—Steps have been taken by the Business Men's Association of Gardner for improving the lighting system in the business district. It is proposed to replace the present lamps with tungsten lamps to be erected on iron standards.

LEOMINSTER, MASS.—The Light, Heat & Power Corporation, of Boston, Mass., is erecting a new boiler plant with all piping and auxiliary apparatus for the Leominster Electric Light & Power Company, Leominster. The boilers have been installed and the smokestack is now being erected. It is expected to have the building completed before the end of the year.

NEWBURYPORT, MASS.—In a decision handed down by the Board of Gas and Electric Commissioners a reduction is ordered in the price of electricity for lamps in Newburyport from 20 cents per kw-hour to 14 cents per kw-hour, and the rate for gas is to be reduced from $1.40 to $1.35 per 1000 cu. ft., to go into effect on Jan. 1, 1911.

NORTH ADAMS, MASS.—The Light, Heat & Power Corporation, of Boston, Mass., has completed the installation of a 1000-kw Allis-Chalmers steam turbine with all auxiliaries for the electrical department of the North Adams Gas Light Company.

PLYMOUTH, MASS.—The Massachusetts Gas & Electric Light Commission has authorized the Plymouth Electric Light Company to issue capital stock to the amount of $30,000, the proceeds to be used to pay for power plant improvements made since its generating equipment was destroyed by fire about a year and one-half ago.

SANDWICH, MASS.—It is reported that the surveys have been completed for the extension of the Plymouth Electric railway from Fresh Pond to Sandwich. It is expected that work will begin early in the spring.

IRON MOUNTAIN, MICH.—O. C. Davidson and L. T. Sterling, of Iron Mountain, Mich., are reported to be interested in a project for the construction of a hydroelectric power plant at the Twin Falls of the Menominee River.

OLIVET, MICH.—It is reported that bids will be received until Dec. 20 by the company recently organized to install an electric light plant for equipment for same. The company is remodeling the local flour mill for a power plant. E. M. Arnos, treasurer of the college, is interested in the project.

PONTIAC, MICH.—The Common Council has passed an ordinance incorporating the proposition of the Michigan Telephone Company as to service, rates and conditions, and annulling the franchise of the Oakland Telephone Company, provided the Michigan State Telephone Company takes over the physical property of the Oakland Telephone Company on terms that have already been arranged.

SANDUSKY, MICH.—The City Council is reported to be considering the question of constructing an electric light plant and water works system. F. T. Benedict is city clerk.

BRAHAM, MINN.—The Eastern Minnesota Power Company, of Pine City, Minn., it is reported, is contemplating extending its system to Braham to furnish electricity for lighting the streets and residences. Twenty-five electric street lamps will be installed.

CLINTON, MINN.—The Minnesota Central Telephone Company is contemplating rebuilding its local exchange, work on which will begin at once.

DEERWOOD, MINN.—M. D. Storer, of Bemidji, Minn., has secured a site for the erection of a warehouse and power house in Bemidji. Contracts have been awarded for equipment for power plant, including a 300-hp Corliss engine and a 200-kw generator.

MINNEAPOLIS, MINN.—The Crown Iron Works Company, of Minneapolis, Minn., is reported to be preparing to build a new fireproof building, 74 ft. x 152 ft., to replace the shop recently destroyed by fire. The new plant will be equipped with a 10-ton electric crane, punches and other machinery and tools.

GULFPORT, MISS—The Gulfport & Mississippi Coast Traction Company is contemplating the extension of its North Gulfport and Twenty-fifth Avenue line to Bayou Banard, and probably into Handsboro.

PORT GIBSON, MISS.—It is reported that plans are being considered for the installation of an electric light plant in the Chamberlain-Hunt Academy with sufficient output to supply 120 lamps. Rev. M. E. Melvin is president.

MARIONVILLE, MO.—The installation of an electric light and pumping plant in Marionville is reported to be under consideration.

ST. LOUIS, MO.—The electric light franchise owned by the Light & Development Company has been declared invalid by Judge Shields, of the United States Circuit Court, because of non-use. The franchise was obtained in 1884 by Aloe Hernstein & Company, who used it a few years, but has not been used for a period of twenty years.

AVON, MONT.—A charter has been granted to a telephone company recently organized by W. H. Whitehall, W. A. Kimmerly, A. R. Grosfield and Henry H. Parker, of Avon. The company is capitalized at $5,000.

CORBIN, MONT.—Plans are being considered by the Corbin Metal Mining Company for the erection of a concentrating plant and installation of additional machinery in its mine.

PHILIPSBURG, MONT.—The farmers of this vicinity are considering the question of co-operating with the government in regard to erecting a telephone line from Philipsburg to the west fork of Rock Creek.

RADERSBURG, MONT.—The Black Friday Mining Company has contracted with the Western Supply Company, of Butte, Mont., for the installation of a new air-compressor and drilling outfit for its mine at Radersburg. Arrangements are being made to discard steam power and install electric motors.

OMAHA, NEB.—The Omaha & Western Iowa Traction Company is reported to be in the market for equipment for its proposed electric railway, which is to connect Sioux City, Ia., and Omaha, Neb., ninety miles in length. Headquarters of the company are at 3901 Eighteenth Street, Omaha, Neb.

WYMORE, NEB.—It is reported that the citizens have voted to issue bonds to the amount of $75,000 for the installation of an electric light plant and water works system.

PORTSMOUTH, N. H.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 7, 1911, for furnishing and installing one electric motor-driven capstan at the Navy Yard, Portsmouth, N. H. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. The cost of the work is estimated at about $3,000. R. C. Hollyday is chief of bureau.

BRANCHVILLE, N. J.—It is reported that Thomas Becker & Sons have secured the contract for the construction of the new power house of the Andover Electric Light Company, work on which will begin within a short time. A new engine and dynamo will be installed.

FLORHAM PARK, N. J.—The City Council has passed the ordinance calling for lighting of the borough. At first the main thoroughfares will be lighted, which will be extended to other streets as soon as the borough is able to provide funds for same.

HARRISON, N. J.—The Mayors of Harrison, East Newark and Kearny have decided to employ an electrical engineer to prepare plans for a municipal electric lighting plant to be owned and operated jointly by the three municipalities. After plans have been prepared steps will be taken to secure legislation to allow the three towns to carry out the project.

NEWARK, N. J.—Plans are being considered for extending the service of the electric lighting plant in the city hall to the other municipal buildings. It is proposed to utilize the New York Telephone Company's conduits, as the franchise of the company provides that the city may use the conduits.

NEWARK, N. J.—Investigations are being made by Morris R. Sherrerd, chief engineer of the Water Department, in regard to the feasibility of utilizing the water power obtained from the Pequonnock watershed in connection with a municipal electric light plant. It is estimated that a fall of approximately 100 ft. could be obtained by diverting the water at the Macopin intake and constructing the plant at Charlottesburg, which would provide sufficient power to operate a plant to supply electricity for lighting all the city buildings and for street lamps.

OCEAN CITY, N. J.—The Millville, Tuckahoe & Ocean City Railroad Company, recently organized, is contemplating the construction of an electric railway from Ocean City to Millville. It is understood the company has acquired the property of the Ocean City Electric Railroad and right-of-way has been secured. It is said that the Edison electric storage battery system will be used. W. Scott Hand is president of the company and C. M. Van Tassell vice-president and treasurer.

ALAMOGORDO, N. M.—The Alamogordo Improvement Company, which is constructing a hydroelectric power plant in Box Canyon, near Alamogordo, is reported to be contemplating the installation of several such plants to provide electricity for industrial purposes.

ENGLE, N. M.—Definite steps have been taken by the Water Users' Association, which is composed of landowners of the Rio Grande Valley who will irrigate from the large water storage and canal system which the United States government is constructing, for the installation of a large hydroelectric power plant to be operated in connection with the Elephant Butte dam and land reclamation project now being constructed by the government. In a report submitted by W. E. Anderson, one of the engineers, the cost of installing the plant and transmission lines down the valley on both sides of the river is estimated at about $326,000. It is proposed that the water users shall bear the expense of installing the proposed plant, the amount to be paid by each shall be prorated by the amount of acreage irrigated, the payments to be made on instalment, and at the end the power plant and transmission system to revert to the Water Users' Association. In addition to providing power for operating pumping plants, there will be a large surplus of energy available for private industries and for municipal purposes, covering a large territory on both the American and Mexican side of the Rio Grande River.

SILVER CITY, N. M.—Boulware & Johnson, of Silver City, N. M., are reported to be preparing plans for the construction of a hydroelectric power plant on the Upper Gila River, work on which will begin in the near future. About 4000 hp will be developed.

ALBANY, N. Y.—Bids will be received by the Board of Contract and Supply until Dec. 19 for furnishing electricity for lighting the streets of the city for a term of five years from June 21, 1911. Isidore Wachsman is secretary of board.

BROOKLYN, N. Y.—Bids will be received by Henry S. Thompson, Commissioner of Water Supply, Gas and Electricity, Room 1904, 13 to 21 Park Row Building, New York, N. Y., until Dec. 21, for furnishing and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places in the Borough of Brooklyn, N. Y. Blank forms may be obtained at the office of the department, Room 2339, Park Row Building, New York, N. Y.

BROOKLYN, N. Y.—Sealed proposals will be received by Henry S. Thompson, Commissioner of Water Supply, Gas and Electricity, Room 1904, 13 to 21 Park Row, New York, N. Y., until Dec 21, for furnishing, maintaining and reserving for use of the high-pressure fire service all apparatus and equipment necessary for generating and transmitting 1850-kw of three-phase, 6600-volt, 25-cycle of electric power and furnishing and delivering this power under terms of contract from Jan. 1 to Dec. 31, 1911, at each of the high-pressure fire service pumping stations located in the Borough of Brooklyn, at Furman and Joralemon Streets and at Willoughby and St. Edwards Streets, respectively. Blank forms may be obtained at the office of the department, Room 2339, Park Row Building, New York, N. Y.

BROOKLYN, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until Dec. 20, for removing four hydraulic elevators in the Kings County Hospital and replacing same with electric elevators. Blank forms and further information may be obtained at the office of the supervising engineer of the department, foot of East Twenty-sixth Street, New York, N. Y., where plans and specifications may be seen. Michael J. Drummond is commissioner.

ELMIRA, N. Y.—The Public Service Commission, Second District, has granted the Elmira Water, Light & Railway Company permission to extend its railway on Pennsylvania Avenue to the city line, thence along Pennsylvania to Southport Corners in Southport.

HOWE CAVE, N. Y.—The Howe Cave Improvement Association is considering the question of establishing an electric street lighting system in Howe Cave. Charles W. Wieland is chairman.

NEW YORK, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 5 for two electric elevators for the United States Assay Office, New York, N. Y., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

NEW YORK, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 3, 1911, for the installation of a conduit and electric wiring system in the United States Assay Office, New York, N. Y., in accordance with plans and specifications, copies of which may be obtained at the above office, or at the office of the superintendent of construction, New York, N. Y. James Knox Taylor is Supervising Architect.

NEW YORK, N. Y.—Bids will be received by Calvin Tomkins, Commissioner of Docks and Ferries, Pier A, foot of Battery Place, North River, New York, N. Y., until Dec. 23 for furnishing electrical supplies, under class 29; for steam steering engines, under class 31, and for watchman's clocks and dials, under class 30. Blank forms and other information may be obtained at the office of the department.

NEW YORK, N. Y.—Bids will be received by the President of the Borough of Manhattan, Room 14, City Hall, New York, N. Y., until Dec. 20, for the erection and installation of an elevator shaft and elevator in the rear of the building located at 264 Madison Street, Borough of Manhattan. Blank forms and specifications may be obtained at the office of the auditor, offices of the Commissioner of Public Works, 13 to 21 Park Row, New York, N. Y. George McAneny is Borough President.

NEW YORK, N. Y.—Proposals will be received by Henry S. Thompson, Commissioner of Water Supply, Gas & Electricity, Room 1904, 13 to 21 Park Row, New York, N. Y., until Dec. 21, for furnishing and maintaining for the use of the high-pressure fire service all apparatus and equipment necessary for generating and transmitting 3250 kw of three-phase, 6600-volt, 25-cycle of electric power and furnishing and delivering this power under terms of contract from Jan. 1, 1911, to Dec. 31, 1911, at each of the high-pressure fire service pumping stations, located in the Borough of Manhattan, at Oliver and South Streets and at Gansevoort and West Streets, respectively. Blank forms may be obtained at the office of the department, Room 2339, Park Row Building, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by Henry Thompson, Commissioner of Department of Water Supply, Gas and Electricity, Room 1904, 13 to 21 Park Row, New York, N. Y., until Dec. 21, for furnishing and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places, from Jan. 1 to Dec. 31, 1911, as follows: No. 1, Borough of Manhattan; No. 2, Borough of the Bronx; No. 3, Boroughs of Manhattan and Bronx; No. 4, Borough of Queens; No. 5, Borough of Richmond. Blank forms may be obtained at the office of the Department of Water Supply, Gas and Electricity, Room 2339, Park Row Building, New York, N. Y.

NIAGARA FALLS, N. Y.—Announcement has been made that the Niagara Falls, Dunnville & Welland Electric Company has decided to begin work immediately on its proposed railway between Niagara Falls, Welland and Dunnville. It is understood that the storage battery system will be used. The company will furnish both freight and passenger service. The cost of the proposed railway is estimated at about $1,000,000.

PAINTED POST, N. Y.—The Village Board has granted a franchise to the Corning Gas & Electric Company, of Corning, N. Y., for a period of thirty years. The company has submitted a proposition to the Village Board offering to furnish arc lamps of 2000 cp at the rate of $80 each per year and 60-cp incandescent lamps for street lighting at $28 per lamp per year, on condition that the village agrees to use fifty of the incandescent lamps or their equivalent. The contract is to be for a term of five years. Work will begin on extension of the transmission from Corning to Painted Post as soon as permission is obtained from the Public Service Commission.

ROCHESTER, N. Y.—The State Water Supply Commission is reported to have adopted final plans for the construction of the storage dam to impound the waters of the upper Genesee River for the purpose of preventing the disastrous floods that have devastated the valley for many years and to develop the water-power of the river in Rochester and at other points along the river.

SILVER SPRINGS, N. Y.—Preparations are being made by the village of Silver Springs for the installation of a combined pumping and electric light plant, work on which will begin in the spring, as soon as the weather will permit. The water supply will be secured from artesian wells yet to be drilled. Bids for the work will not be called for. J. C. Nash is village president.

SOLVAY, N. Y.—It is reported that the Village Trustees are contemplating reopening the local lighting plant, which has been abandoned for some time. It is understood that bids have been asked for installation of a generator and overhauling the plant. Edwin Hall is village clerk.

SYRACUSE, N. Y.—The Syracuse Lighting Company is reported to have secured franchises in the villages of Camillus and Solvay to supply electricity for lamps and motors.

VOORHEESVILLE, N. Y.—The residents of Voorheesville have petitioned the Albany Illuminating Company to extend its transmission line to this village. It is understood that the company is willing to grant the request, provided the village authorities will grant a franchise. Many of the residents will install electric lamps, and it is expected that the streets of the village will be lighted by electricity later.

WHITESBORO, N. Y.—The Board of Trustees has awarded a contract for lighting the streets of the village to the Utica Gas & Electric Company, of Utica, N. Y., for a period of five years, under the terms of which the company is to supply 2000-cp arc lamps at $75 each per year, with an all-night service, to take effect from Jan. 1, 1911. About forty lamps will be required.

HETTINGER, N. D.—The Lodgepole Telephone Company, recently organized, is planning to erect a telephone line between Hettinger and Lodge Pole.

CINCINNATI, OHIO.—It is reported that Smith & Mills, manufacturers of machine tools, are erecting an addition to their plant on Spring Grove Avenue, Cincinnati, which will be equipped with a 100-hp Miller gas engine and generator to provide electricity for lamps and motors for the machine shop.

CLEVELAND, OHIO.—The City Council has adopted a resolution asking the State Legislature to enact a law which will give the Council or some city official power to supervise the operation of telephone systems within the limits of the municipality. This action has been taken owing to frequent complaints that are being made regarding the service.

CLEVELAND, OHIO.—Preparations have been made by the Perry-Payne Company, of Cleveland, Ohio, for the construction of a large power plant on Oregon Avenue, Cleveland. The building will be 125 ft. x 87 ft., five stories high and will cost about $80,000.

CLEVELAND, OHIO.—The Shaker Heights Land Company is considering plans for the construction of an electric railway across the Shaker Lakes Park connecting with the Cleveland Railway at Coventry Road.

COLUMBUS, OHIO.—A company is being organized for the purpose of supplying electricity to that portion of the city north of Broadway and all suburbs north of Columbus, including the village of Worthington, with electricity for lamps and motors. Energy for the service will be supplied by the Columbus, Delaware & Marion Railway Company and a transformer station will be installed at Chaseland, from which transmission lines will be erected on the poles of the railroad company. George W. Meeker is at the head of the project.

NELSONVILLE, OHIO.—Preparations are being made by the Hocking-Sunday Creek Traction Company for extending its railway in the spring. It is said that a bond issue of $200,000 has been provided for.

ROSSFORD, OHIO.—Preparations are being made by the Ford Plate Glass Company for extensive additions to its plant, which will include the erection of fourteen new reinforced concrete buildings, at a cost of more than $1,000,000. Among the buildings will be a power house 70 ft. x 160 ft., and a boiler house 60 ft. x 192 ft.

TOLEDO, OHIO.—The Bunting Brass & Bronze Company, of Alliance,

Ohio, is reported to be in the market for foundry equipment for its new plant to be erected in Toledo, Ohio, including motors and generators, air compressors, 5-ton crane, and milling machines.

TOLEDO, OHIO.—It is reported that the Maumee Valley Electric Company, which some time ago was refused admission into Toledo, has secured entrance to the heart of the city through an unexpected source. The State has granted the company permission to erect transmission lines on the banks of the Miami and Erie Canal. The poles have already been erected and it is expected that the plant will be in operation in a short time.

KIOWA, OKLA.—Preparations are being made to enlarge the electric light plant and water-works system, for which bonds to the amount of $18,000 have been voted. Bids will be received until Jan. 1 for the work. W. N. Vernon is president of board of trustees.

OKLAHOMA CITY, OKLA.—The Oklahoma City & Fort Smith Traction Company is reported to be making preparations for the construction of its proposed electric railway to connect Oklahoma City, Okla., and Fort Smith, Ark., 200 miles in length, for which, it is said, bids will be received Jan. 1, 1911. Joseph Kreis, of Oklahoma City, Okla., is general manager and chief engineer.

STILWELL, OKLA.—At an election held Nov. 29 the citizens voted to issue $5,000 in bonds, the proceeds to be used for the installation of an electric light plant.

DALLAS, ORE.—The contract for the construction of the proposed street railway in Dallas has been awarded to Frank P. Phillips. The railway will provide for both passenger and freight traffic and will eventually be extended into the country. E. W. Thomas is interested in the project.

SPRINGFIELD, ORE.—The Northwestern Corporation, of Eugene, Ore., is reported to be planning to erect a substation in Springfield to supply the upper Willamette Valley with electricity for lamps and motors.

THE DALLES, ORE.—Preparations are being made by the Pacific Power & Light Company for the installation of a 1500-hp water wheel in January, increasing the output to 3700 hp.

VALE, ORE.—The Malheur Home Telephone Company, recently organized with a capital stock of $75,000, has taken over the plant and holdings of the Malheur Telephone Company. It is understood that the new company will make considerable improvements to the system, including the erection of a new exchange building. J. E. Jennings, of Salt Lake City, Utah; M. G. Heope and T. W. Halleway are interested in the new company.

BELLWOOD, PA.—The plant and holdings of the Bellwood Electric Light Company are reported to have been purchased by the Blair Electric Company, which is owned and operated by the American Railways Company, of Philadelphia, Pa.

HAZLETON, PA.—Plans have been prepared by A. W. Leh, 203 West Fourth Street, South Bethlehem, Pa., for the construction of a hotel to be erected on Broad Street, in Lancaster, for James Loughran. The proposed building will be 30 ft. x 160 ft. A power plant and two passenger elevators will be installed. It is understood that bids will be called for construction of same during the latter part of January or early in February.

NORTHUMBERLAND, PA.—The capital stock of the Commonwealth Telephone Company has been increased from $120,000 to $200,000.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 27, for furnishing and erecting a 15-ton traveling crane at the Navy Yard, Philadelphia, Pa., under schedule No. 3151.

PHILADELPHIA, PA.—Plans are being prepared by Bergdoll & Pawling for the construction of a large factory building for Alexander Brothers, manufacturers of leather belting, to be erected at 414 and 416 Third Street, adjointing its present plant. It is understood that additional power plant equipment will be required.

PITTSBURGH, PA.—Bids will be received at the office of the City Controller until Dec. 19 for furnishing and maintaining arc or incandescent electric lamps and incandescent mantle lamps for lighting the streets, boulevards, alleys and parks of the City of Pittsburgh for a term of one year. Specifications and blanks can be secured at the general office of the Department of Public Works. Joseph G. Armstrong is director of public works.

WILKES-BARRE, PA.—The Wyoming Valley Traction Company is making improvements to its power plant on South Main Street for the purpose of supplying more power for its Duryea and Hughestown lines.

ROCK HILL, S. C.—The Board of Public Works has awarded contracts for equipment for the proposed municipal electric light plant as follows: For generators and other electrical equipment to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.; for poles to the Charlotte Supply Company, and to the Southern Electric Company for wire and cross-arms.

DEADWOOD, S. D.—Plans are being considered by the Gilt Edge Maid Mining Company for the erection of a smelter at its property, located near Deadwood.

EGAN, S. D.—The installation of a municipal electric light plant in Egan is reported to be under consideration.

ST. LAWRENCE, S. D.—The installation of an electric light plant in St. Lawrence is under consideration. It is reported that the equipment of the old plant in Miller, S. D., will be installed here.

BRISTOL, TENN.—Plans are being considered by the Board of Trade of the two Bristols for the construction of an electric railway from Bristol to Kingsport, a distance of twenty-five miles. George L. Carter, president of the C. C. & O. Railway, is reported to be interested in the project.

SIOUX FALLS, S. D.—The Sioux Falls Light & Power Company is reported to be making extensive additions to its auxiliary steam power plant. It is understood that other improvements are to follow.

SOUTH PITTSBURG, TENN.—Harry Patton is reported to have purchased an interest in the local electric light plant and will remodel the same. Charles Houston is manager.

EL PASO, TEX.—The El Paso Electric Railway Company is considering the erection of transmission lines from its power plant down the valley of the Rio Grande River for the purpose of supplying electricity for operating irrigation pumping plants and other industries.

GEORGETOWN, TEX.—The City Council is making preparations to take over the plant and holdings of the Georgetown Water, Light & Power Company on or before Jan. 1, 1911. The price paid for the plant is said to be $13,500. Extensive improvements and extensions will be made to both the water and electric service, which will involve an expenditure of about $31,500.

LAMPASAS, TEX.—It is reported that the plant and holdings of the Lampasas Light & Power Company have been purchased by E. Haby. The new owner, it is said, will erect a new power station and install additional equipment, at a cost of about $15,000.

LA PORTE, TEX.—The Bay Shore Rapid Transit Company, it is reported, will soon purchase steel and equipment for its proposed electric railway to connect La Porte and Houston. O. L. Allen is interested in the project.

MARFA, TEX.—It is reported that the St. Stephen Land Company is contemplating the construction of a storage reservoir and the installation of a large amount of irrigating pumping machinery on its property near Marfa.

SAN ANGELO, TEX.—The San Angelo National Bank has filed foreclosure proceedings against the San Angelo Street Railway Company, and a date for the sale of the property will be fixed by the court. It is understood that two syndicates contemplate bidding on the property, and it is stated that whichever syndicate purchases the railway important extensions and improvements will be made.

TAYLOR, TEX.—The International & Great Northern Railroad Company is erecting reinforced concrete buildings in connection with its car repairing shops at Taylor, Tex., including a power house and round house. Air compressor machinery will be installed.

VICTORIA, TEX.—Application has been made to the City Council by D. D. Fairchild, Jr., of San Antonio, Tex., for a franchise to construct and operate an electric street railway in Victoria.

WACO, TEX.—The City Council is reported to be considering the question of issuing bonds for the construction of a municipal electric light plant.

BRIGHAM CITY, UTAH.—It is reported that contracts have been placed for an 850-hp Pelton Francis turbine and a Westinghouse generator for the municipal electric light plant at Brigham City. The turbine is to operate under a 1280-ft. head.

SALT LAKE CITY, UTAH.—It is reported that the Utah, Nevada & Idaho Telephone Company will increase its capital stock from $200,000 to $600,000, to provide funds for extensions, principally throughout the State of Nevada. Extensions have been authorized to the through line west from Salt Lake City to Ely, Nev., and north through Montello to a connection with the new copper camp at Contact. Several lines will be erected to supply Reno, Carson and San Francisco connections, among which will be a line from Reno through Lovelock to a connection with Winnemucca and the famous camp of National. Another line will be erected from Fallon to Austin and also a line to connect the town of Mason with Salt Lake City.

UINTAH, UTAH.—Work has commenced on the construction of a hydroelectric power plant in Weber Canyon, near Uintah, for the Davis and Weber Counties Canal Company. The proposed plant will have an ultimate output of 15,000 hp and will supply electricity for an irrigation system now operating in Weber and Davis Counties. The initial installation will be limited to about 6000 hp. The water will be carried to the power house in steel penstocks. H. A. Strauss, vice-president and chief engineer of the Falkenau Electrical Construction Company, of Chicago, Ill., has charge of the work. E. P. Ellison, of Layton, Utah, is president of the canal company.

COVINGTON, VA.—The Town Council has ordered an election to be held Feb. 11, 1911, to vote on the proposition to issue $50,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant. R. W. Crowder is Acting Mayor.

CHEHALIS, WASH.—The Valley Development Company is reported to be preparing plans for the construction of a new power plant in the Big Bottom country, work on which will begin about Feb. 1, 1911.

HANFORD, WASH.—It is reported that the Pacific Light & Power Company is contemplating extending its transmission line south to Richmond and possibly to Kennewick.

NORTH YAKIMA, WASH.—The Pacific Light & Power Company has entered into a contract with the White Bluffs Land & Irrigation Company to supply electricity for operating pumping plants for irrigating purposes. The Pacific Light & Power Company is planning to extend its transmis-

sion line to Black Rock, a distance of sixteen miles. G. C. Arrowsmith is manager of the Yakima division.

REPUBLIC, WASH.—The Knob Hill Mining Company is reported to be considering the question of installing an air compressor plant and other equipment between now and spring.

SEATTLE, WASH.—The new plant of the International Lime Company, now under construction near Seattle, Wash., will be placed in operation in the near future. The plant will be equipped for electrical operation throughout.

SPOKANE, WASH.—The Washington Consolidated Telegraph & Telephone Company, recently incorporated with a capital stock of $1,000,000, proposes to take over a number of smaller and independent telephone systems in this vicinity. C. M. Cooley, of Spokane, and others are interested in the company.

TACOMA, WASH.—The Seattle-Tacoma Power Company has been granted a franchise by the Commissioners of Pierce County to erect a high-tension transmission line from the south boundary of the Puyallup Indian reservation to North Puyallup.

TACOMA, WASH.—The Equality Telephone Company has applied to the Commissioners of Pierce County for a franchise to erect telephone lines on certain of the county roads. George W. Edwards, W. H. Pierce and others are interested in the enterprise.

TACOMA, WASH.—The Municipal Commission has voted to double the size of the Nisqually power plant. The present plans prepared by Frank C. Kelsey, former chief engineer, provide for a plant of 16,000 hp, to cost $1,700,000. At an additional cost of $150,738 Commissioner Nicholas Lawson, of the Department of Light and Water, states that he can build a plant with an output of 32,000 hp.

WALLA WALLA, WASH.—It is understood that the transmission line of the Pacific Power & Light Company, to be extended to the Freewater country to supply electricity to pump water to irrigate 11,000 acres, will probably be extended to include from 40,000 to 50,000 acres.

CHARLESTON, W. VA.—The Kanawha Water & Light Company is reported to be preparing plans for rewiring the entire business district of the city and buildings supplied with electrical service.

BENTON, WIS.—Plans are being considered by the Wisconsin Zinc Company for the installation of a power plant and concentrating plant at its Winskill Mine, near Benton.

NORTH MILWAUKEE, WIS.—The Home Brewing Company is reported to be contemplating the erection of a brewery in North Milwaukee. A power plant will be installed.

STOUGHTON, WIS.—Negotiations have been closed whereby the City of Stoughton will purchase the water rights and property of the Stoughton Milling Company. The consideration is said to be $18,700. The property has been purchased to be used in connection with the proposed plan for increasing the output of the municipal electric light and power plant for operating the pumping station of the water works system by electricity. The cost of the improvements is estimated at about $8,000.

TOMAHAWK, WIS.—It is reported that a company is being organized by W. T. Bradley, of Tomahawk, Wis., to erect a soap factory here. The plant will be equipped for electrical operation.

VIOLA, WIS.—The construction of a concrete dam across the Kickapoo River to provide power for an electric light plant to be installed next spring is reported to be under consideration.

WEST ALLIS, WIS.—The Standard Separator Company, of Milwaukee, Wis., has purchased a site in West Allis, Wis., on which it proposes to erect a manufacturing plant, 250 ft. x 550 ft., one story high. An electric power plant will be installed and the machinery equipped for electric motor drive.

LARAMIE, WYO.—Extensive improvements are being made to the plant of the Laramie Electric Company, of Laramie, including the reinforcement of feeder lines, the installation of a new switchboard, new boilers and a general overhauling of the station apparatus.

RAWLINS, WYO.—The passing of an ordinance requiring uniform electrical installations is being strongly advocated in Rawlins.

NANAIMO, B. C., CAN.—It is reported that negotiations are under way between the citizens of Nanaimo and the Dominion Stock & Bond Corporation, of Vancouver, B. C., Can., for the construction of an electric railway in this city. The proposition will probably be submitted to a vote.

VANCOUVER, B. C., CAN.—It is reported that surveys have been completed for the proposed electric railway to extend from Bakerville to Fort George, a distance of about 150 miles. A hydroelectric power plant will be erected to furnish power to operate the proposed road. It is understood that work will begin in the spring. Mr. Murphy, of Vancouver, is reported to have charge of the construction work.

KINGSTON, ONT., CAN.—The managers of the light, heat and power plant have recommended improvements to the street lighting system, which will involve an expenditure of $13,000.

LONDON, ONT., CAN.—Owing to the installation of the Hydro-Electric Power Commission's service the manufacturers who have been using electricity supplied by the local plant will have to change their motors. Most of the motors are of the direct-current type, whereas the city now supplies alternating-current. It is understood that more than 300 motors will have to be changed.

MARMORA, ONT., CAN.—The by-law authorizing the purchase of the Marmora Electric Light Company by the municipality was carried by a large majority.

NORTH TORONTO, ONT., CAN.—The City Council is considering the question of installing an electric light plant at a cost of about $20,000 to supply electricity for lighting the streets and residences in North Toronto.

OTTAWA, ONT., CAN.—Announcement has been made by Adam Beck, of the Hydro-Electric Power Commission, that the entire transmission line carrying electricity at 11,000 volts to all the chief centers of Ontario, west of and including Toronto, will be completed and in operation before Jan. 1, 1911. The entire pole line will be 290 miles in length.

STRATFORD, ONT., CAN.—A by-law asking for an appropriation for electric lighting purposes will be submitted to the ratepayers.

VILLA ALTA, OAXACA, MEX.—Plans are being prepared by the Cajones Mining Company for the erection of a stamp mill having a daily capacity of 200 tons at Villa Alta. A 300-hp hydroelectric power plant will also be installed.

New Industrial Companies.

THE BATTEN-DAYTON MOTOR COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $125,000 by William O. Dayton, M. A. Dayton and Edmund S. Carr. The company proposes to manufacture motors and accessories.

THE BUTTE ELECTRICAL SUPPLY COMPANY, of Butte, Mont., has been incorporated with a capital stock of $250,000. The company has opened a wholesale house in Butte with five branch retail stores, two of which will be located in Helena, Mont., one each at Great Falls, Billings and Missoula, Mont. R. W. Nichol is president and general manager, L. H. Allen is vice-president and assistant manager and E. E. Brazier is manager.

THE COOPER HEWITT ELECTRIC COMPANY, of Hoboken, N. J., has been incorporated by George Whitefield Betts, Jr., of Englewood, N. J.; William Hazen Peck, of Glen Ridge, and Reese D. Alsop, 96 Remsen Street, Brooklyn, N. Y. The company is capitalized at $2,500,000 and proposes to acquire, own and work patents relating to lamps in which vapor forms a portion of the conducting circuit. The office of the company is located at 703 Grand Street, Hoboken, N. J.

THE DICKERSON MANUFACTURING & SUPPLY COMPANY, of Clinton, Ill., has been incorporated with a capital stock of $200,000 to manufacture a water gage for steam boilers of all kinds, locomotives, marine and stationary, invented by Charles L. Dickerson, president of the company.

THE DYNETO ELECTRIC COMPANY, of Elbridge, N. Y., has been chartered by A. E. Doman, C. L. Amos and A. A. Costello, of Syracuse, N. Y. The company is capitalized at $60,000 and proposes to manufacture electric and mechanical devices, etc.

THE ELECTRICAL LAUNDRYING COMPANY, of Waterville, Maine, has been organized with a capital stock of $10,000 for the purpose of manufacturing and dealing in apparatus for electrical laundrying and conducting a laundry business. Fred C. Dunlap, of Skowhegan, Maine, is president, and W. R. Pattangall, of Waterville, is treasurer.

THE ELECTRODE COMPANY OF AMERICA, of Niagara Falls, N. Y., has been granted a charter with a capital stock of $200,000 for the purpose of manufacturing electrodes and carbon articles of all kinds. The incorporators are: Paul L. T. Heroult, the Ansonia, Broadway and Seventy-third Street, New York, N. Y.; William P. Marseilles, of Niagara Falls, N. Y.; Albert Stetson, 38 Park Row, and Fred White, 718 West 178th Street, both of New York, N. Y.

THE GALE INSTALLATION COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing and dealing in electrical appliances, etc. The incorporators are: N. Eley, Hugo Thal and Frank S. Swett.

THE HOLBECK RIVERSIDE GAS POWER COMPANY, of Oil City, Pa., has been chartered by John D. Smithman, H. H. Smithman and Joseph M. Jenckes. The company is capitalized at $1,000,000 and proposes to establish a plant for the manufacture of engines, compressors, boilers and tanks.

THE MOTOR SAFETY CRANK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by M. G. Worth, F. A. Linn and G. Reif, of New York, N. Y. The company proposes to manufacture motors, engines and accessories.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, of St. Paul, Minn., has filed articles of incorporation under the laws of the State of New Jersey with a capital stock of $600,000. All the capital stock of the company is said to be held by Minnesota people. F. B. Thompson, of St. Paul, Minn., is the Minnesota representative.

THE OSCAR MILLER COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $120,000 for the purpose of dealing in calculating machines. The incorporators are: O. Miller, P. B. Thompson and H. C. Beadleston, of New York, N. Y.

THE OZONE GENERATOR & ENGINEERING COMPANY, of New York, N. Y., has been incorporated by Dr. J. G. Atkinson, 1134 Pacific Street; Clarence S. Woodman, 333 Lewis Avenue, both of Brooklyn,

N. Y., and Joseph B. Unlacke, 756 West 168th Street, New York, N. Y. The company is capitalized at $20,000, and proposes to manufacture electrical water purifying devices, etc.

THE PETERSON RERUM BATTERY COMPANY, of Charles City, Ia., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing electric batteries. It is understood that the company expects to erect a large factory in the spring.

THE SHAW PROPELLER COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing engines, etc. E. W. Richardson, of Brighton, Mass., is president, and J. B. Leake, of Boston, Mass., treasurer.

THE WESTERN MOTOR SUPPLY COMPANY, of El Paso, Tex., has been chartered with a capital stock of $6,000 by P. J. Savage, George W. Kennedy and John T. Fletcher.

THE W. T. WOOD COMPANY, of Waterloo, Ia., has been incorporated for the purpose of manufacturing wagons, farm trucks, gasoline engines, etc. W. T. Wood is president of the company.

New Incorporations.

STOCKTON, CAL.—The Western States Gas & Electric Company has been incorporated with a capital stock of $15,000,000 for the purpose of taking over the properties of the Stockton Gas & Electric Company and the Richmond Electric Company in Contra Costa County. H. M. Byllesby & Company, of Chicago, Ill., are interested in the new company.

BRUNSWICK, GA.—The St. Simonds Island Railway Company has been incorporated with a capital stock of $20,000 by Frank D. Aikin, A. Fendig, F. D. M. Strachan, J. B. Wright and others, of Brunswick, Ga., and M. Kiser, of New York, N. Y. The company proposes to construct a street railway system on St. Simonds Island, near Brunswick.

PAYETTE, IDAHO.—Articles of incorporation have been filed for the Salmon Falls Light & Power Company with a capital stock of $100,000 by A. E. Wright, J. M. Swanson, W. C. Sturdevent, James Spofford and J. H. Wright. The company proposes to operate an electric light and power plant, flour mills, saw and planing mills.

WARDNER, IDAHO.—The Washington Water Power Company, of Spokane, Wash., has completed its new substation at Wardner. The new station will have an output of 1500 kw and will supply electricity to operate the machinery in the mines and ore-handling plants of the Bunker Hill and Sullivan Mining Company.

CHAMPAIGN, ILL.—The Bloomington, Decatur & Champaign Railroad Company has been incorporated with a capital stock of $3,525,000 by B. E. Bramble, W. H. Carnahan and G. R. McComb, of Champaign, Ill. The company proposes to construct and operate a railway from Bloomington to Decatur, thence to Champaign, Ill.

CHICAGO, ILL.—The Ardmore Electric & Gas Company has been incorporated by C. C. Hessen, E. M. Hammond, G. A. Jewett and Charles C. Hamilton. The company is capitalized at $10,000 and proposes to manufacture and distribute electricity for lamps and motors and also gas.

CHICAGO HEIGHTS, ILL.—Articles of incorporation have been filed for the Chicago, Terre Haute & Southeastern Railway Company with a capital stock of $2,500,000 for the purpose of constructing and operating a railway from Chicago Heights to Edgar County, Ill. The incorporators are: M. D. Lawlor, O. A. Bestal and E. A. Stake, of Chicago, Ill.

ELGIN, ILL.—The Elgin Belt Railway Company has been granted a charter to construct and operate an electric railway to connect Elgin and Desplaines. The company is capitalized at $25,000 and the incorporators are: P. Freller, J. Newman and J. M. Blackburn.

ELKADER, IA.—The Boardman & Wagner Telephone Company has been incorporated with a capital stock of $1,000.

BOWLING GREEN, KY.—The Bowling Green & Northern Railroad Company has filed articles of incorporation with a capital stock of $30,000 to construct an electric railway from Bowling Green to Leitchfield. The incorporators are: B. F. Gardner, M. H. Crump and C. H. Felton.

HAGERSTOWN, MD.—The Hagerstown & Clear Spring Railway Company has been incorporated to construct an electric railway to connect Hagerstown, Clear Spring, Md., and Mercersburg, Pa., a distance of twenty-five miles. L. F. Downs, of New York, N. Y., and James B. Kreps, of Hagerstown, Md., are interested in the project.

BUFFALO, N. Y.—Articles of incorporation have been filed for the International Traction Railways, of Buffalo. The company is capitalized at $100,000 and proposes to operate an electric railway in the Abbott Road, Buffalo, between Cazenovia Street and the southerly line of Buffalo. The directors are: Morris Cohn, Jr., of Niagara Falls, N. Y.; Robert L. Fryer, O. P. Letchworth, of Buffalo, N. Y.; Thomas E. Mitten, of Chicago, Ill.; Edmund B. Osler, of Toronto, Ont., Can., and Nelson Robinson, of New York, N. Y.

STACKHOUSE, N. C.—The Madison County Railway Company has been chartered with a capital stock of $50,000 by E. B. McMillan and others. The company proposes to build an electric railway to connect Stackhouse and Allenstand, ten miles in length.

SEBRING, OHIO.—The McKee Light & Power Company has been incorporated by S. E. McKee, L. E. McKee, F. W. McKee and William J. Hanna.

NEWVILLE, PA.—The Green Spring Rural Telephone Company has been organized to construct and operate a telephone line between Newville, Green Spring and vicinity.

NORRISTOWN, PA.—Charters have been granted by the Secretary of State to the Plymouth Electric Company, Lewes Providence Company and the West Norristown Electric Company, all of Norristown, Pa. Each company is capitalized at $3,000. H. H. Ganser is treasurer.

SASSAMANSVILLE, PA.—Articles of incorporation have been filed for the Douglas Telephone Company with a capital stock of $5,000.

CLARK, S. D.—A charter has been granted to the Day-Merton Telephone Company with a capital stock of $2,000. The incorporators are: C. D. McClelland, Julius Kropp and C. P. Enwright.

FATE, TEX.—The Hackberry Telephone Company has been incorporated with a capital stock of $500 by William Zollner, C. Zollner and Matthew Zollner, Jr.

ASHLAND, WIS.—Articles of incorporation have been filed for the Gogebic & Iron County Railway & Light Company with a capital stock of $100,000. The company proposes to develop a water power in northern Wisconsin and build an interurban railway system.

GRAFTON, WIS.—The Grafton Light, Heat & Power Company has been incorporated with a capital stock of $20,000 by Herman N. Croehuke, August Croehuke and John G. Busch.

Personal.

MR. E. D. ADAMS has made a gift of $3,000 to Columbia University for the purpose of establishing and maintaining a "Deutsches Haus."

MR. GEORGE J. LIVER, who has been connected with the Metropolitan Electric Supply Company, of Chicago, for eight years, has been promoted to the position of sales manager of that company.

MR. H. C. WORTHEN, formerly chief inspector of the Western Union Telegraph Company in New York, has been appointed superintendent of the Southern division of that company with headquarters in Atlanta, to succeed B. F. Dillon, who died a very short time ago.

MR. FREDERICK SARGENT, of Sargent & Lundy, engineers, has sailed for Europe. Mr. Sargent is accompanied by Mrs. Sargent, and the two will spend the holidays with their daughter, who is being educated abroad. He will return to his office in Chicago about the middle of January.

MR. W. H. SMAW, formerly assistant to the purchasing agent for the Georgia Railway & Electric Company, has been promoted to the position of purchasing agent of that company to succeed Mr. George B. Graves, who recently resigned. Mr. W. G. Thomas, formerly storekeeper for the company, has been appointed assistant to the purchasing agent. Mr. Smaw has been with the Georgia Railway & Electric Company for the past eight years in the capacity of clerk and assistant to purchasing agent.

MR. A. L. POND, who is now the manager of the Chicago office of the Fort Wayne Electric Works, was acting manager for some time prior to his recent appointment, succeeding Mr. Walter Goll, now located at the company's branch in Madison, Wis. Mr. Pond has been connected with the Fort Wayne company for about five years, and prior to that was superintendent of the water works and electric light plant in the City of Coldwater, Mich. Before that again Mr. Pond had a wide experience both in the central-station and manufacturing and selling end of the electrical business.

MR. FRANK L. PERRY, widely known among electrical men in Chicago, has returned to that city from a summer and autumn sojourn in Baltimore, where he demonstrated his versatility by organizing a classified advertising department for the Baltimore *Sun* after an exhaustive investigation of the advertising methods of the Chicago daily papers. During a four-month campaign Mr. Perry organized a new classified advertising department, as the result of which the *Sun* is making large gains in this class of business compared with any previous period in its history. So pleased was Mr. C. H. Grasty, president of the *Sun*, with the work of Mr. Perry that he presented to him as a trophy a handsome silver cup, standing 11 in. high, suitably inscribed to the winner of the "Classified Sweepstakes."

MR. CHARLES G. ARMSTRONG, consulting engineer, of New York City, has taken into partnership his son, Mr. Francis J. Armstrong, under the firm name of Charles G. Armstrong & Son. Mr. Charles G. Armstrong is well known, particularly in connection with the planning and construction of the Auditorium Hotel, Stock Exchange Building, Lake Shore Passenger Station and the Coliseum in Chicago, and the Singer Building and United States Express buildings in New York City. Mr. Armstrong is also the inventor of many modern office building devices, particularly the elevator signaling system which is now in practically universal use. Mr. Francis J. Armstrong is a graduate of the Manual Training School of the Chicago University and of the Stevens Institute of Technology. He has been engaged with his father in consulting engineering work for the past year.

Obituary.

MR. FRANK S. GORTON, who was prominent a number of years ago in the affairs of the Chicago Edison Company, predecessor of the Commonwealth Edison Company, died in his apartments at the Congress Hotel, Chicago, on Monday evening, Dec. 12, from an attack of asthma. For a number of years Mr. Gorton was secretary and treasurer and a director of the Chicago Edison Company, and for a time, prior to the coming of Mr. Samuel Insull as president in 1892, he was conspicuous in the administration of the company. Later he acquired a considerable interest in the Chicago Pneumatic Tool Company, but he retired from active business in 1903.

MR. CARL BAJOHR, a lightning-rod manufacturer of St. Louis, died on Nov. 30 after an illness of several months. He was one of the leading makers and erectors of lightning rods in the country and maintained branch offices in New York and Chicago. He made a specialty of lightning protection for churches, smokestacks and high buildings, and is said to have obtained orders to place lightning rods on the White House, as well as other government contracts. He received awards for lightning conductors at the St. Louis World's Fair and other exhibitions. Mr. Bajohr was born in Königsberg, Germany, fifty-three years ago, and began his studies of lightning protection in Germany.

WILLIAM HENRY BRYAN.—The last issue of the *Electrical World,* containing a personal item to the effect that William Henry Bryan, formerly a consulting engineer of St. Louis, had removed to Chicago in consequence of his appointment as chief engineer of the Board of Education of the latter city, was hardly off the press when the sad news came of his being found dead from heart failure in a Chicago hotel, only a few days after he reached the city to take up his new position. Mr. Bryan was born in Washington County, Mo., Aug. 14, 1860. After preparatory schooling at Smith Academy, St. Louis, he was graduated from Washington University in mechanical and electrical engineering in 1881. His first position was with the Pond Engineering Company, after which he was appointed manager of the Chicago office of the Yale & Towne Company. In 1890 he formed a partnership with Mr. H. H. Humphrey, of St. Louis, as a firm of consulting mechanical and electrical engineers. Since this partnership was dissolved in 1899 Mr. Bryan had maintained his own office as a consulting engineer in St. Louis until his appointment to the position of chief engineer of the Chicago Board of Education, following his success in taking the civil service examination, where he received the highest mark. Besides his widow and three daughters, Lucile, Agnes and Minnie, Mr. Bryan is survived by two sons—Walter, who is electrical foreman for the United States Incandescent Lamp Company, St Louis, and Ralph, a student in the architectural school of Washington University. Mr. Bryan was a member of the American Institute of Electrical Engineers and several times president of the Engineers' Club of St. Louis. He was also an active member and several times president of the Washington University Alumini and the Washington University Association. Besides his well-known work as consulting engineer in mechanical and clerical fields, he was called into consultation in several important water-works cases at Kansas City, Buffalo and Omaha, and at the time of his death had in preparation an engineers' handbook on the subject of heating and ventilation, the manuscript of which is unfinished. On the day of Mr. Bryan's demise (Dec. 5) he was apparently in good health, and he had retired to his room at the Plaza Hotel, Chicago, where his body was discovered a number of hours later, after it had been found impossible to obtain response to telephone calls or knocks on the door.

MR. W. H. BRYAN.

MR. WILLIAM J. WHETZELL, owner of the electric service system of Eureka, Ill., was killed on Nov. 26, as the result of a distressing accident in the plant. Mr. Whetzell's stations furnish electrical energy to Eureka, and also to the near-by villages of Roanoke and Metamora. On the day of his death Mr. Whetzell was busily engaged about his Eureka plant, and in some way he was caught in the flywheel of the engine and the main driving belt and so badly injured that he died a few minutes afterward without being able to speak. His two young sons were the only persons who witnessed the accident, but these boys—one ten and the other five years of age—were unable to render any assistance. They cried for help, however, and the day engineer was attracted to the spot and shut down the plant. Mr. Whetzell was removed to the office of the station, but he was in a dying condition and soon ceased to breathe. The dead man was highly esteemed by all who knew him, both in his home town and elsewhere. He was born in Virginia in 1865, but went to Illinois with his parents at the age of five years. After finishing school he took up the work of teaching and he was elected county superintendent of schools of Woodford County in 1898. In that year he removed to Eureka and he made a fine record as school superintendent. Retiring from school work, Mr. Whetzell erected the electric light plant in Eureka, and for four years he had been successfully engaged in building up the business. He extended the system to Roanoke and Metamora, towns lying seven and nine miles distant respectively, and recently instituted a day service in all three villages. He was a man of character, determination and industry, and his unexpected death was a painful shock to his friends. A widow and five children, the oldest twelve years of age, survive him.

Trade Publications.

FLOOR OUTLETS.—Numerous types of floor outlets for use with conduit wiring are illustrated, listed and described in a catalogue issued by the Steel City Electric Company, 507 Washington Avenue, Pittsburgh, Pa.

INDUCTION MOTORS.—The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has issued circular No. 1188, describing a line of polyphase slip-ring motors designed especially for cranes, hoists and elevators.

ADJUSTABLE-SPEED MOTORS.—Adjustable-speed motors of the variable-reluctance type are described in bulletin No. 54 of the Stow Manufacturing Company, Binghamton, N. Y. These motors are rated at from one-quarter to 20 hp.

COAL MINE STORAGE BATTERY.—Bulletin No. 129 of the Electric Storage Battery Company has for its subject the storage battery installation forming part of the mining plant of the New River & Pocahontas Consolidated Coal Company, at Gentry, W. Va. Lighting, power and haulage are provided from three 300-kw generators regulation being afforded by a "chloride" battery of 114 cells, having a capacity of 320 amp for twenty minutes and 640 amp in regulating rapid fluctuation of load.

BUSINESS NOTES.

THE TRIUMPH ICE MACHINE COMPANY, which is occupying its new plant at Oakley, Ohio, has arranged to open an office in the Fourth National Bank Building, Cincinnati.

THE GYRO MOTOR COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $100,000. The incorporators are: E. Berliner, R. S. Moore and J. L. Simmons, of Washington, D. C.

THE SCIPLE-GOUCHENOUR COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $18,000 by H. M. Sciple, W. E. Gouchenour and C. B. Sands, all of Philadelphia, Pa. The company proposes to manufacture boilers and other machinery.

MR. DUGALD CRAWFORD HILL has been elected secretary of the Metropolitan Electrical Supply Company, of Chicago. Mr. Hill is not an electrical man, but he has had a good business training under the tutelage of Marshall Field & Co., and is well equipped for his new field of endeavor.

THE MACKEY MOTOR COMPANY, of Newark, N. J., has been incorporated with a capital stock of $300,000 for the purpose of manufacturing motor boats, automobiles, engines, etc. The incorporators are: J. C. Mackey, W. G. Jerolemon, of Newark, N. J., and R. M. Bateman, of East Orange, N. J.

AUTOMOBILE COMPANY ADOPTS CONNECTICUT SHOCK ABSORBERS.—As a result of comparative tests, the Knox Automobile Company, of Springfield, Mass., has adopted Connecticut shock absorbers as regular equipment on all 1911 cars. These shock absorbers, which have been on the market but a short time, are manufactured by the Connecticut Shock Absorber Company, Meriden, Conn.

THE LATHBURY-D'OLIER COMPANY, Philadelphia, announces a merger of the interests of B. B. Lathbury, consulting engineer (formerly president of Lathbury & Spackman, Inc.), and of the D'Olier Engineering Company. The company, with enlarged scope and facilities, will continue the general and special engineering, manufacturing and contracting business heretofore carried on by the respective interests. The offices of the company are in the Morris Building, Philadelphia.

ROYSE ELECTRIC COMPANY, INDIANAPOLIS, SOLD.—The Royse Electric Company, of Indianapolis, has changed hands. The new owners have taken over the entire holdings of the old company, the name of which is changed to the Indianapolis Electric Supply Company, with the following officers: R. P. Oblinger, president; H. E. Rasmussen, vice-president; C. E. Kennedy, secretary; R. A. Macgregor, treasurer. A general electrical jobbing business will be carried on.

H. B. LOGAN, president of Dossert & Company, has been elected president of the American Oil Storage Company, a New Jersey corporation capitalized at $500,000, which has the patent rights for the manufacture, sale and rentals of Keefe's Patent Sectional Steel Flange Storage Tanks. Mr. Logan is well known in electrical trade circles through his connection with the successful development of Dossert solderless connectors. He will continue at the head of Dossert & Company. The New York office of the American Oil Storage Company is at 74 Broadway.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED, DEC. 5, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

977,336. MEANS FOR FILTERING AIR AND PRODUCING OZONE; S. C. Shaffner and S. T. Hutton, Chicago, Ill. App. filed June 26, 1909. A plurality of electrodes produce the field, alternate electrodes being inclosed and the intermediate ones exposed. A step-up transformer charges them.

977,354. ELECTRIC RAILWAY; R. P. Williams, San Francisco, Cal. App. filed Oct. 29, 1908. For third-rail system, the trolleys being connected with a source of electrical supply and the car trucks having dependent arms to contact with the trolleys.

977,361. RADIANT ELECTRIC HEATER; R. W. Baker, New York, N. Y., and V. L. King, Woodridge, N. J., and H. C. Parker, New York, N. Y. App. filed Dec. 29, 1909. A radiant electric heater including a stiff non-metallic resistor in filament form which when cold conducts and glows when the current flows through it, together with electrical connections for the resistor and a containing globe open to the air for a filament.

977,398. TROLLEY RETRIEVER; N. Peterson, Omaha, Neb. App. filed July 29, 1909. A support with trunnions which carries a resilient member and trolley yoke with angular slots, the trunnions engaging the slots.

977,400. BRUSH-HOLDER; F. W. Reeves, Pittsburgh, Pa. App. filed March 7, 1910. A pair of brushes slide in a holder with yielding springs on opposite sides to give longitudinal pressure.

977,401. ELECTRIC CONTACT SHOE; C. C. Rich, Mount Vernon, N. Y. App. filed July 6, 1909. A contact shoe with a main member having a longitudinal opening, an auxiliary member, mounted therein with end tongues and side tongues and springs on opposite sides of the slot bearing upon the side tongues.

977,416. TROLLEY HEAD; E. N. McCall, Goldfield, Nev. App. filed Dec. 21, 1908. Details in the construction of a trolley head which includes two trolley wheels in tandem upon a yoke pivotally mounted upon the trolley arm.

13,178. CONTROLLER; E. Schattner, London, Eng. App. filed Sept. 12, 1910. A motor starting rheostat with a self-reducing carbon resistance and a movable switch arm, which short-circuits the resistance, and which is retarded.

977,443. STORAGE BATTERY PLATE; B. Ford, Philadelphia, Pa. App. filed April 14, 1910. Has a lug and consists of groups of leaves and ribs with a web adjacent to the lug and terminating on an angle to the top of the plate.

977,446. PENDANT; C. D. Gervin, New York, N. Y. App. filed March 26, 1908. An electrical switch with a rotable spindle and a plunger telescoping over the spindle and a spring acting when the plunger is released for rapidly rotating the spindle.

977,447. CUT-OUT TELEPHONE SYSTEM; E. Gould, Spring Valley, Minn. App. filed Oct. 14, 1908. A magneto circuit for a telephone system with selecting switches at different stations, bell circuits and a lever which connects the magnetos with the bells on either side of the line, and may also connect the speaking and listening circuits.

977,452. TELEGRAPH SENDING MACHINE; J. R. Jones, Port Arthur, Ontario, Canada. App. filed Feb. 9, 1910. Portable sending of the automatic type mounted on a pivoted frame which can be inserted in place of the ordinary key and a pendulum within the casing or frame for sending dots and dashes by a movement of the casing.

977,456. RESISTANCE DEVICE; H. W. Leonard, Bronxville, N. Y. App. filed March 29, 1909. Field rheostat for a large generator or for use as a heater in which resistance units are used, each unit comprising a metal conductor exposed to the air supported on insulators, the distance between which can be adjusted.

977,460. CONTACT FINGER FOR ELECTRICAL CONTROLLERS AND SWITCHES; R. C. Lyness, Sunderland, Eng. App. filed June 27, 1910. Comprises a metal strip with one end bent to form a loop and a contact tip with a recess embracing the loop.

977,476. TROLLEY CATCHER; F. J. Roache, Somerville, Mass. App. filed Nov. 12, 1909. A spring actuated drum to receive the trolley rope and a fixed plate with a groove containing a locking member, moves the locking member more or less as the drum turns.

977,521. ELECTRICALLY IGNITED BURNER; E. J. Goldblatt, Chicago, Ill. App. filed Feb. 21, 1910. A housing of non-conducting material with a passage for the gas and a pair of electrodes in the material of the housing terminating in proximity to the burner tip with connecting plugs at opposite ends.

977,536. AUTOMATIC SWITCH FOR TELEPHONE SYSTEMS; G. H. North, Cleveland, Ohio. App. filed Dec. 8, 1908. Fixed contacts passed over by a selecting arm operated by a plurality of electro-magnets, which electro-magnets are interchangeable.

977,554. ELECTRICAL EQUALIZER SYSTEM; O. S. Schairer, Pittsburg, Pa. App. filed Sept. 3, 1907. Means for equalizing the load upon the generator station when the load upon its system is variable. using a fly wheel connected to a dynamo operating as a motor or generator and directly connected to the distributing circuit without the intervention of a rotary converter.

977,571. SYSTEM OF ELECTRIC MOTOR CONTROL; W. H. Thompson, Wilkinsburg, Pa. App. filed Jan. 5, 1907. Electric motor for gate valves, etc., in which the circuit is opened to stop the motor and then closed to reverse it, and then again opened, this bringing the motor to rest a short space.

977,577. ELECTROMAGNET; R. Wikander, Edgewood Park, Pa. App. filed Aug. 2, 1905. A magnetizing coil with a movable core which operates a pair of toggles and a pair of links between the core and the toggles and a spring between the toggle and the contacts.

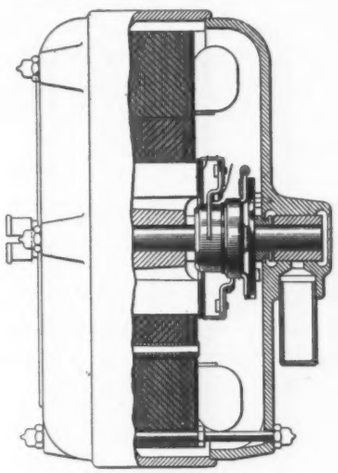
977,580. ELECTRIC HEATING AND COOKING APPARATUS; T. Abtmeyer, Wilkinsburg, Pa. App. filed May 13, 1909. Toasting apparatus, each resistance unit having a stamped metal envelope, the units being secured to a frame, edge to edge.

977,591. CENTRIFUGAL SWITCH; W. J. Brandon, Wilkinsburg, Pa. App. filed Sept. 8, 1908. For single-phase motor. The switch includes stationary concentric terminal cylinders of differents and electrically connected rotatable brushes to engage it with the cylinders, except when rotated at a greater speed than the predetermined speed.

977,595. ELECTRICALLY OPERATED SWITCH; F. Chamness and J. P. Kriegbaum, Huntington, Ind. App. filed Oct. 12, 1909. Tongue point switch operated by a solenoid magnet the circuit through which is controlled through a battery on the car and a contact arm.

977,597. SYSTEM OF OPERATION FOR ALTERNATING-CURRENT MOTORS AND GENERATORS; W. Cooper, Pittsburg, Pa. App. filed Sept. 3, 1907. Alternating current distributing circuit with a generator, an exciter for the field with the field connected to the distributing circuit with means for adjusting the phase supplied to the circuit with relation to the E. M. F.

977,598. ELECTRICAL EQUALIZER SYSTEM; W. Cooper, Pittsburg, Pa. App. filed Sept. 3, 1907. A dynamo operating either as a motor or generator mechanically connected to a flywheel and directly connected to a distributing circuit without the intervention of the rotary converter with means for adjusting the field of the machine to cause it to operate as a motor on failure of current and as a generator on excess current with means for adjusting the phases of the electromotive force of the field.



977,591.—Centrifugal Switch.

977,607. ARC LAMP ELECTRODE; G. Egly, Berlin, Germany. App. filed Sept. 9, 1909. Inclosed arc lamp in which the electrode consists of a plurality of cores containing an illuminating mixture, each of the cores embedded in a thin carbon shell with a wall of substantially uniform thickness, the shells symmetrically disposed in cross-section.

977,616. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Jan. 29, 1910. Has a flat mouthpiece. A diaphragm is stretched over the aperture and carries a deep cone at the center which is secured to one of the electrodes.

977,617. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Feb. 24, 1910. A flat mouthpiece with a screen secured to the front and a cup-shaped member secured to a diaphragm which rests against the front electrode.

977,618. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Oct. 1, 1910. Has a flat mouthpiece and is sanitary. Makes use of a guard which is perforated and can be detachably secured over the front of the transmitter.

977,619. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Feb. 12, 1910. A guard of a screen-like form forward of the aperture and a plurality of arms near the margin of the aperture for preventing tampering with the diaphragm.

977,620. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Jan. 28, 1910. A casing with an apertured front and a resistance cup, comprising the electrodes with the casing, a diaphragm closing the front of the casing and a shell between the diaphragm and the front electrode for transmitting the sound therethrough.

977,621. SOUND REPRODUCING DEVICE; F. Gottschalk, New York, N. Y. App. filed Oct. 25, 1909. A telephone transmitter with a resistance cup in the front of the casing and a cup-shaped diaphragm next to the cup supported upon a stud connected to the front electrode.

977,622. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed Feb. 25, 1910. Sanitary transmitter in which a cup-shaped shell projects into the mouthpiece and is connected to a diaphragm in contact with the resistance element.

977,623. TELEPHONE TRANSMITTER; F. Gottschalk, New York, N. Y. App. filed March 24, 1910. A diaphragm between the variable resistance and the front wall of the casing with a cup extending into the mouthpiece aperture to concentrate the sounds.

977,625. ELECTRICALLY HEATED DEVICE; W. S. Hadaway, Jr., East Orange, N. J. App. filed May 1, 1909. An electrically heated laundry roll, including an outer shell, an inner cylinder with a higher coefficient of expansion and an insulated electric resistance between the shell and the cylinder.

977,626. ELECTRIC TOASTER; W. S. Hadaway, Jr., East Orange, N. J. App. filed May 1, 1909. Includes a supporting frame with a plurality of cross bars and sections of resistance ribbon supported at the edges by the bars and insulated therefrom.

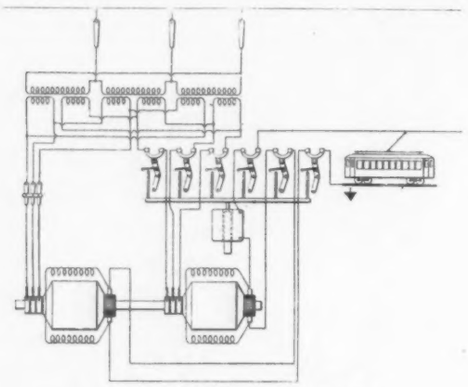
977,640. SYSTEM OF OPERATION FOR DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburg, Pa. App. filed March 15, 1906. For preventing alternating motors of the commutator type from being converted into direct-current generators by combining with the field and armature an impedance device in shunt to the field, the field of which is magnetically saturated when a predetermined amount of current traverses the field.

977,641. SYSTEM FOR OPERATION OF DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburg, Pa. App. filed March 15, 1906.

For electric railways and motors of the commutator type with series field and armature to prevent unstable action, the field when the motor is operating as a generator has substantially constant excitation by supplying it from a phase changing device between the field and the circuit to which the armature is connected so that the e.m.f of the armature agrees with that of the circuit to which the armature is connected.

977,642. MEANS FOR EFFECTING TELEPHONIC COMMUNICATION WITHOUT CONNECTING WIRES; H. G. Matthews, Gloucester, Eng. App. filed June 18, 1910. Acts by induction and a loop of wire is supplied with high frequency currents in circuit with a transmitting telephone and rotary disk of aluminum upon which a steel shoe presses, opposing resistance which breaks down under the rotation of the disk.

977,643. OUTLET BOX; E. R. La Manquais, Economy, Pa. App. filed Sept. 10, 1909. An outlet box having a body with a rear portion surrounded by a rim with threaded orifices in the body.



977,645.—System of Distribution.

977,645. SYSTEM OF DISTRIBUTION; P. M. Lincoln, Pittsburgh, Pa. App. filed Feb. 3, 1910. Rotary converter railway system for high voltage work in which a direct current circuit is used, as well as an alternating current circuit and two mechanically coupled rotary converters are connected to both circuits which may be simultaneously disconnected from the direct circuit and one from the alternating circuit on short circuit.

977,648. MEANS FOR PROTECTING ELECTRICAL CIRCUITS; P. MacGahan, Wilkinsburg, Pa. App. filed Jan. 10, 1908. Parallel transmission lines are protected from overloads by means of circuit breakers controlled by two switches, one closed when the circuit reverses and the other kept open when the circuit is traversed in the normal direction and closed when the circuit is reversed.

977,649. PROTECTIVE DEVICE FOR ELECTRICAL CIRCUITS; P MacGahan, Wilkinsburg, Pa. App. filed Jan. 10, 1908. For protecting parallel transmission lines from overloads by means of a circuit-breaker and switch, the latter having a magnet winding and means for establishing a low resistance circuit for the said winding when the circuit reverses and a high resistance circuit when the circuit becomes overloaded.

977,657. TELEPHONE TRANSMISSION SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Sept. 2, 1909. Substation telephone devices in connection with a long-distance transmission line, making use of a receiver of particular form and a separate bridge between the line conductors and the secondary of the induction coil, and an independent bridge across the conductors, especially for railway telephone work.

977,658. TELEPHONE DESK STAND; W. Leaver, Chicago, Ill. App. filed March 3, 1908. The parts are concealed and the transmitter back casing and lug are integral. A cylindrical transmitter is supported within the conical cap provided with a slot and a spring within the cap holds the cap and support in frictional relation.

977,664. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; J. K. Lux, St. Louis, Mo. App. filed April 26, 1906. Snap switch for switchboards in which the knives are operated by a yielding starter and strike up against a yielding buffer.

977,711. METHOD OF ELECTRIC WELDING; J. F. Craven, Pittsburg, Pa. App. filed March 5, 1909. For welding sheets in thin plates by means of a stiffening ring inside of the overlapping portions and an electric rotary welding tool supplied with current rolling down the welded joint.

977,713. ELECTRIC CABLE; J. H. Cuntz, Hoboken, N. J. App. filed March 29, 1901. For preventing distortion in cables for submarine work by increasing its inductance so as to counteract the distributed capacity of the line, the conductor being continuously wound helically about a non-current carrying core, the core being of stranded material.

977,721. ELECTRIC BATTERY; C. J. Everett, New York, N. Y. App filed March 6, 1905. Water-tight box for inclosing a battery and switch.

977,768. DYNAMO ELECTRIC MACHINE; J. B. Wiard, Lynn, Mass. App. filed April 27, 1910. Has a stationary core with holes for receiving a cooling fluid and end-clamping frames with grooves registering with the holes.

977,774. ARC LAMP SAFETY DEVICE; O. F. Asbury, Charlotte, N. C. App. filed Feb. 8, 1909. For preventing the feeding carbon from short-circuiting through the frame when the other carbon burns out by means of a swinging member which intercepts the feeding carbon when it burns away.

977,784. ALTERNATING-CURRENT GENERATOR AND MOTOR SYSTEM; Wm. Copper, Pittsburgh, Pa. App. filed Sept. 3, 1907. For railways using dynamos of the commutator type supplying alternating current or to act as motors. The exciter that supplies the field of the generator has its field connected to the distributing circuit and a resistance in circuit with the field is used for adjusting the phase supplied to the distributing circuit with respect to its e.m.f.

977,797. ELECTRICAL SWITCH; W. P. Hammond, Passaic, N. J. App. filed Feb. 24, 1908. Waterproof switch for motor boats in which all the contacts, etc., are within a watertight base.

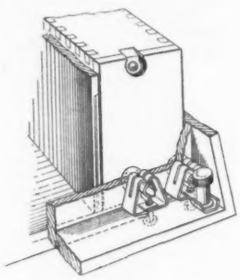
977,810. OPERATING MEANS FOR ROTARY ELECTRIC SWITCHES; J. K. Lux, Washington, D. C. App. filed Dec. 4, 1906. Rotary snap switch in which the handle contains a plunger which engages the spindle, which spindle is engaged by a spring and an expansible disk retains the plunger in position.

977,821. ALTERNATING-CURRENT DYNAMO ELECTRIC MACHINE; M. Milch, Schenectady, N. Y. App. filed April 8, 1904. Has a fluctuating field, a rotor with a commutator, brushes bearing thereon with means for inducing an equal and opposite e.m.f. in the coil, short-circuited by the brushes by means of the fluctuating field so as reduce sparking.

977,836. FIXED POLARITY ATTACHMENT PLUG; C. D. Platt, Bridgeport, Conn. App. filed April 25, 1910. For charging batteries and the like which can only be inserted one way into the sockets. Details.

977,870. INDUCTION COIL; J. O. Heinze, Jr., Lowell, Mass. App. filed May 22, 1909. Spark coil in which the box contains two coils with two secondary terminals of the spark gap connected to each secondary, each pair of terminals forming a spark gap of suitable length when the coils are in normal position.

977,879. ELECTRIC TELEGRAPHY; J. Kajiura, Tokyo, Japan. App. filed April 4, 1910. Semi-bridge duplex system for cable and telegraphic circuits with overhead line wires with means for reducing the capacity of the artificial cables by means of an artificial line



977,870.—Induction Coil.

corresponding to the line cable and a balancing rheostat with self-inductances, resistance and capacities branching from the center of the rheostat.

977,912. MOTOR CONTROL SYSTEM; H. E. White, Schenectady, N. Y. App. filed July 19, 1910. Motor controller with movable contacts and contact fingers with magnets energized from the motor circuit on overload for holding the fingers out of engagement with the contacts.

977,981. TELEPHONE RECEIVER; H. R. Stuart, Wheeling, W. Va. App. filed March 21, 1908. Improvement in telegraphones to produce a sensitive receiver. A pair of magnets in ring form with opposed pole pieces are arranged on opposite sides of a diaphragm and the system inclosed in a casing from each end of which the sound conveying tubes project.

977,984. GRAPHITE ARTICLE AND METHOD OF MAKING THE SAME; Frank T. Tone, Niagara Falls, N. Y. App. filed Nov. 11, 1905. Artificial graphite in the state of molecular separation of a certain density.

978,004. ELECTRICAL CUT-OUT; J. L. Burton, Plainville, Conn. App. filed Feb. 11, 1910. A fuse member with a tubular body containing the fuse and a clip with a shank hitting the body and a disk closing an end of the tube to which the fuse is connected.

978,022. ELECTRICAL RESISTANCE CONTACT, AND THE LIKE; H. S. Hatfield, Hove, Eng. App. filed Dec. 28, 1906. Consists of a body of silicon with a surface coating of an alloy of silicon and another metal.

978,038. SYSTEM OF REGENERATIVE CONTROL FOR ELECTRIC MOTORS; B. J. Lamme, Pittsburgh, Pa. App. filed March 15, 1906. For electric railways employing motors of the commutator type with series connected fields and armatures which may be operated as generators under stable conditions. Makes use of a source of current to be connected in shunt to the field when the machine is operated as a generator.

978,053. SWITCH-OPERATED MECHANISM; E. S. Olmsted, Louisville, Ky. App. filed July 1, 1910. The track switch is thrown automatically and electrically by the approaching car. Controlled through a solenoid magnet, the wires being run in tubes to protect them.

978,070. TELEPHONE TRANSMITTER; J. Sparks, Kimberly, Cal. App. filed March 30, 1910. Pneumatic microphone transmitter in which a valve chest receives fluid under pressure, the valve being operated by the diaphragm of the mouthpiece and the fluid pressure operating circuits for reproducing the sound electrically.

978,075. TELEPHONE MOUTHPIECE; G. R. Taylor, San Francisco, Cal. App. filed Sept. 27, 1909. A mouthpiece supported a short distance away from the transmitter button with an open space between.

978,079. KEYBOARD TELEGRAPH TRANSMITTER; D. S. Troth, Oakland, Cal. App. filed May 8, 1909. A plurality of rotating disks with recesses and contacts adjacent thereto engaging the recesses, a contact bar for transmitting the code.

978,083. TELEPHONE REPEATER SYSTEM; N. G. Warth, Columbus, Ohio. App. filed July 15, 1907. A main line secondary and a primary repeater with two local or tertiary circuits each connected with the repeater, one inductively connected with the main line secondary and the primary repeater and the other with the primary repeater circuit only.

978,094. INCANDESCENT ELECTRIC LAMP; A. L. Wilkins, Middleton, Mass. App. filed Sept. 13, 1909. The filament is composed of alternate sections of carbon and tungsten in series.

978,112. TRANSPORTATION SYSTEM; W. C. Carr, Buffalo, N. Y. App. filed Dec. 11, 1908. Overhead rail system in which the car is supported and depends from the side rails, which rails are supported on posts. Details in the construction of the rush and other parts of the system.

978,119. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed May 13, 1910. A lifting magnet in which the winding consists of superposed sections, each a flat spiral with spacing between the sections and passages leading to the outside of the winding to admit insulating compound, and to drive out the air.